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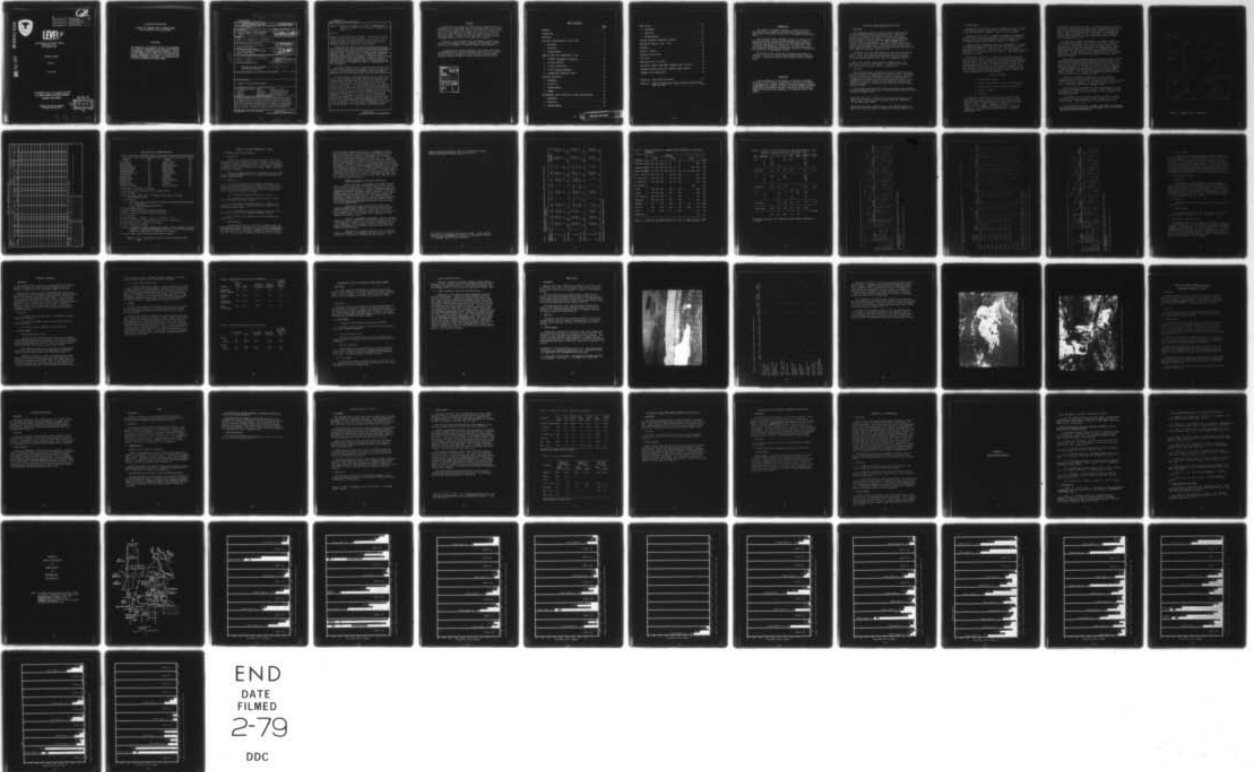
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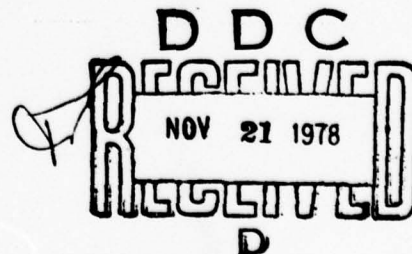
TRIENNIAL REPORT

Volume I

June 1978

ENVIRONMENTAL AND LIFE SCIENCES DIVISION
U.S. ARMY DUGWAY PROVING GROUND
Dugway, Utah 84022

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selected, common rodents and jackrabbits have been analyzed in greater depth than they were previously. Epidemiology and toxicology information has been obtained from these native fauna specimens as well as from domestic livestock and wild horses. Methods of detecting tularemia have been improved.

Determination of baseline erythrocyte acetylcholinesterase (AChE) activity levels in wildlife and livestock has been completed. No significant differences were found in levels of AChE by geographic area. The AChE levels in livestock were significantly higher in early spring than in fall collections, but wildlife exhibited minimal seasonal differences. These AChE baseline values have been applied to the investigations of known or suspected exposure events. No toxicological impact has been detected, but work will continue to determine the effect of organophosphorus on the environment.

The deaths of numerous horses during the week of 4 July 1976 in the Orr Springs area at DPG prompted intensive investigations. Scientists and investigators from several cooperating agencies determined that the horse deaths were caused by severe dehydration.

In-house Laboratory Independent Research (ILIR) studies which relate to the primary mission functions of the Environmental and Ecology Branch have been included, for the first time, in this regular Progress Report. One such project includes serologic activity, particularly of California encephalitis virus. Others include the following: (1) Cooperative studies on outbreaks of bovine anthrax in Utah revealed a soil origin fostered by altered climatic conditions. (2) A study of preinstallation history has been initiated, as required in Federal Antiquities Act of 1906 and subsequent legislation. (3) Studies on fleas continue with emphasis on a joint project entitled "Fleas of North America: Ecology and Systematics". (4) At the request of the Utah State Veterinarian, an accidental parathion poisoning episode in 180 cattle in Utah was investigated, and decontamination aid was given to the cattle owner. (5) The presence of endangered species in the fauna and flora of the Dugway area is being investigated.

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FOREWORD

Epidemiological, ecological and toxicological investigations conducted by the U.S. Army Dugway Proving Ground under RDT&E Project Number 1T161101A91A and TECOM Project Number 7-CO-1LT-DPI-001 to meet part of the mission requirements of the Organization, Mission and Functions (DPGR 10-3, July 1975 pages 20-8 and 20-9) comprise Volume I of this two-volume report. Related work performed under In-house Laboratory Independent Research (ILIR) is also summarized in Volume I.

Progress on other customer-funded environmental studies and preparation of environmental impact assessments and statements for DPG activities are presented in a separate summary report, Volume II.

In conducting the research described in this report, the investigators adhered to the "Guide to Laboratory Animal Facilities and Care" as promulgated by the Committee on the Guide for Laboratory Animal Resources, National Academy of Sciences, National Research Council.

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INTRODUCTION

This report is intended to furnish an in-depth evaluation of data from field and laboratory investigations in support of the environmental and ecological tasks at U.S. Army Dugway Proving Ground. (DPG).

Since the early 1950's, the impact of the U.S. Army activities upon the environment has been studied continuously by ecological, epidemiological, and toxicological surveillance under the guidance of advisory committees (e.g., Scheele and Price Committee). This program has been planned and conducted by a variety of specialists well informed in methodology and techniques required for the detection and amelioration of environmental insults.

During 1951 to 1973, the natural environment was studied intensively, with primary interest directed toward enzootic infections in nature. Toxicological studies were initiated as part of Program SAFEST.

OBJECTIVES

The main objective of this program is to provide a continuous ecological and toxicological surveillance of the natural environment in the Dugway area. Studies include environmental ecology, ecological epidemiology and ecological toxicology, and the development of applied techniques of environmental analysis. Publication of environmental reports of this work in the literature is an important facet of this program.

ECOLOGICAL INVESTIGATIONS OF NATIVE FAUNA

1. BACKGROUND

Field sampling has been the principal means of gathering data for the environmental and ecology studies at DPG. Results and discussions of previous field sampling have been presented in preceding annual reports of progress.¹ Current efforts emphasize studies on the black-tailed jackrabbit (*Lepus californicus*) as an indicator animal. The jackrabbit is an ideal indicator animal because of its broad distribution, daytime visibility, ease of counting and limited breeding season. These factors make possible jackrabbit population studies at minimal cost over the broad area (90 by 110 miles) under the influence of DPG activities.

Jackrabbit tallies have been made twice a year (March and August), and all of the counts have been totaled into one figure for each season. Counts were separated from component areas, and the population trends were plotted for these areas in the Bonneville Basin.

Much of this work has been presented in annual reports. Revaluation of past work is now underway. A portion of the revaluation, dealing with jackrabbit counts, is reported here.

2. OBJECTIVES

The 1974 annual report of progress² presented the objectives and described procedures followed during 1974, 1975 and 1976. The detailed plan for Ecological and Epidemiological Studies of Zoonotic Infections at Dugway Proving Ground, beginning in 1976, describes and defines epidemiological studies as an organization mission and function. Most pathogens of concern as diseases in nature have been reviewed, with emphasis on tularemia. A new collecting schedule and level of effort were established.

The principal objective of this portion of the effort was to obtain detailed information on demography. A preliminary hand tabulation served to guide the computer work.

¹Dugway Proving Ground. A study of the Ecology and Epizootology of the Native Fauna of the Great Salt Lake Desert 1963-1973. DAAD-09-69 (or year applicable)-C-0030

²Dugway Proving Ground. Ecology Studies in the Bonneville Basin of West Central Utah 1974 RDT&E 1X-6-65704-DL14-5; DPG-FR-X100P Nov 1976

3. ACCOMPLISHMENTS

Collections of rodents and jackrabbits presented in Table 1, page 5, of the 1974 progress report were made on an established schedule. Collection sites are shown in Figure 1, page 4, of the same report.

Trapping success is given in Figures B-1 through B-15 (Appendix B) as total animals captured per 100 traps and capture rate for the pre-dominant rodent species Ammospermophilus leucurus, Dipodomys ordii and Peromyscus maniculatus, plus total numbers of all species.

Eutamias minimus, Perognathus formosus, P. longimembris, D. microps and Peromyscus crinitus were sometimes exceedingly numerous in certain areas (as high foothills or vegetated dunes). Detailed laboratory sampling and analyses were carried out on the first three rodent species, jackrabbits, all carnivore species and livestock. Blood samples were divided for toxicology.

The census of jackrabbits is a separate field exercise from the collection of specimens. The transects (119) have been counted each March and August. The area covered by the 119 transects was subdivided into six smaller areas based upon natural geographic barriers such as mountain ranges or salt flats. An effort was made to include 10 or more transects within each chosen area, but this arrangement was not always possible. Each area count was totaled for each season (Figure 1), and the resulting totals were reduced to numbers of rabbits per square kilometer by the following equation:¹

$$\text{Density} = \frac{N}{A} = \frac{2n-1}{2Lr}$$

r = mean flushing distance

L = length of one transect (1 mile or 1.61 kilometers)

n = average number of animals observed per transect

N = number of rabbits

A = unit area

Gross et al.² discuss the limitations of this equation and suggest that the counts be expressed as an area index, which may differ from the absolute density by some factor dependent on the

¹Gates, C.E. 1969. "Simulation study of estimators for the line transect sampling method." Biometrics 25:317-328.

²Gross, J.E., L.C. Stoddart and F.H. Wagner 1974. "Demographic analysis of a northern Utah jackrabbit population." Wildlife Monographs 40:1-68.

limitations of the counting procedure. Using drive count, Gross et al. were able to estimate the absolute jackrabbit population density for portions of the Curlew Valley and suggest that it equals 1.43 times the density index in the Curlew Valley. Further work will be needed, however, to determine whether this factor may apply to the DPG figures. At least three areas have population trends significantly different from the Dugway Valley area.

The Blue Lake - Ibapah area population, for example, showed an interesting population drop in the Spring of 1971 after a peak in the Fall of 1970. The population then slowly recovered, and the high population persisted 1 year longer than in the Dugway Valley. Quite unexpected was the phase shift exhibited by the Lakeside-North Skull Valley population, and the more striking phase difference noted in Rush Valley. The data from these areas resembled those from the Dugway Valley, and such phase shifts between adjacent areas have not been reported previously.

Other aspects of jackrabbit ecology and population dynamics studies have produced voluminous and continuous data (except 1975 and 1976) from collections and observations made during the last 12 years. These data are being placed into computer retrieval for final and accurate tabulation and analysis. Description of the 119 transects conducted in March and August each year are given in previous Progress Reports.¹ A preliminary analysis of relative density using uncorrected data is shown in Figure 1. Age structure and reproductive biology data area also being introduced for computer retrieval.

A portion of reproduction information is shown in Figure 2. Conception dates seem to be clumped. There were at least three distinct periods of conception in 1973 and four or five indistinct periods in 1974. Data were inadequate for 1975, and none were taken during 1976. Collection of these data was resumed in 1977.

Carnivore captures and results of tests for hemagglutinating (HA) antibodies to tularemia are shown in Tables 1 and 2. These carnivores were captured by steel traps and collected by rifle in mountains and sand dunes within DPG.

The locations of herds of cattle and flocks of sheep around DPG at the time of sampling are shown in Figure 2, Page 10, of the 1974 Progress Report. Blood samples were taken from the jugular vein.

¹U.S. Army Dugway Proving Ground. A Study of the Ecology and Epizootology of the Native Fauna of the Great Salt Lake Desert 1963-1973. DA-42-007-AMC-35(R) and DA-42-007-AMC-227(R).

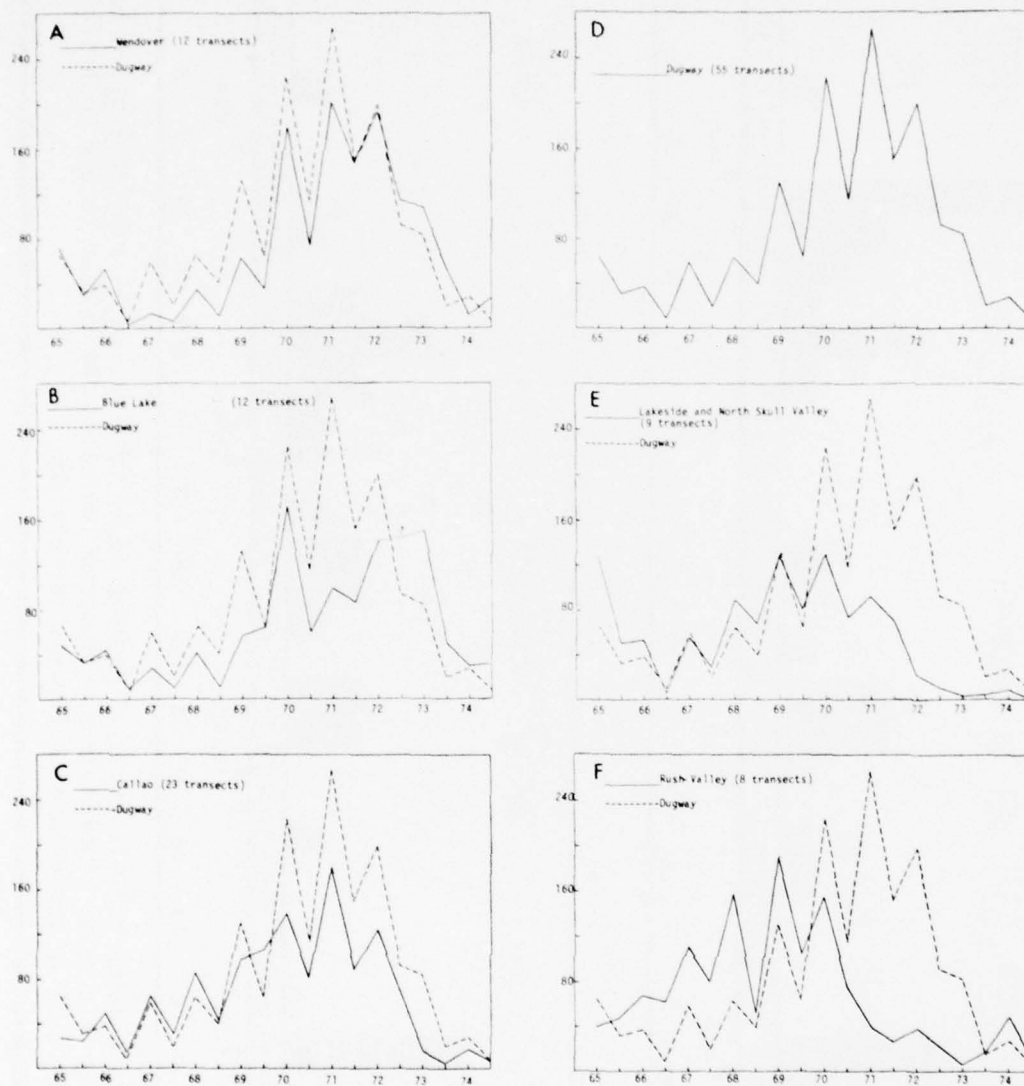


Figure 1. Transect counts of jackrabbits

Research was conducted on modification of the 3 in. by 3 in. Havahart trap, which could replace the can trap (a 1-liter oil can fastened to a "Museum Special" snap trap). The modifications of the Havahart trap consist of springs on the "keepers", which better hold the door shut regardless of position of the trap, and an extender on the treadle, which provides extra leverage. In several field trials, the modified Havahart trap caught up to three times as many animals as the can trap and held animals significantly better than the unmodified Havahart.

The Field and Laboratory Sheet was redesigned (Figure 3) to better account for total trapping results, to serve as a single sheet to carry through all laboratory operations, and to provide a list of code symbols on the back of the last sheet of multiple sheet form (Figure 4), which eliminates the necessity of carrying a separate list in the field.

FIELD AND LABORATORY DATA SHEET

[illegible]

STEDP-TOL Form 3, (Rev) 15 Jan 75

CODE REFERRING TO NUMBERED HEADINGS

- (1) Species: Common species are abbreviated as follows: Other mammals rarely encountered and birds and other species may be written out under comments and remarks with numbers or letters referring to each specimen on each sheet.

MAMMAL	CODE	MAMMAL	CODE
<i>Lepus californicus</i>	Lc	<i>Peromyscus crinitus</i>	Pc
<i>Lepus townsendii</i>	Lt	<i>Peromyscus truei</i>	Pt
<i>Sylvilagus audubonii</i>	Sa	<i>Onychomys leucogaster</i>	O1
<i>Spermophilus townsendii</i>	St	<i>Neotoma lepida</i>	N1
<i>Spermophilus variegatus</i>	Sv	<i>Lagurus curtatus</i>	Lag
<i>Spermophilus lateralis</i>	S1	<i>Microtus montanus</i>	Mm
<i>Ammospermophilus leucurus</i>	A1	<i>Microtus longicaudus</i>	M1
<i>Eutamias minimus</i>	Em	<i>Mus musculus</i>	Mus
<i>Eutamias dorsalis</i>	Ed	<i>Canis latrans</i>	C1
<i>Perognathus formosus</i>	Pf	<i>Vulpes macrotis</i>	Vm
<i>Perognathus parvus</i>	Pp	<i>Urocyon cinereargenteus</i>	Uc
<i>Dipodomys ordii</i>	Do	<i>Taxidea taxus</i>	Tt
<i>Dipodomys microps</i>	Dm	<i>Lynx rufus</i>	Lr
<i>Reithrodontomys megalotis</i>	Rm	<i>Peromyscus maniculatus</i>	Pm

- (2) Blood Sample: T = Toxicology E = Epizootology
- (3) I.D. number ear tag or toe clip read inner to outer, left to right, rear to front
- (4) GTS = Grid Trapsite
- (5) Age = JSA - Juvenile, Subadult or Adult 1 A - Immature or Adult; estimate from size. Pelage
If adult comment on sex status
- Sex Status (write in)
- Males: Position and size of testes; undescended or descended (scrotal) epididymus, small or large; weight of testes in grams
- Females: vagina open or plugged, pregnant, lactating
- (6) XL: Average length of all embryos
- (7) Mortality - Calculated by subtracting total embryos from corpora lutea
- (8) Con Due: Conception and delivery date calculated from age of embryo
- (9) CL - Corpora lutea
- (10) Kind of Ectoparasites = C - chiggers F - fleas L - lice M - mites T - ticks
- (11) Tissue (write in tissue taken) e.g., Blood clot, Bone marrow, Kidney, Liver, Lung, Spleen, etc.
- (12) Pathogen (write in) e.g., liver and spleen positive for tularemia
- (13) Line - Set each line in only one habitat
- (14) Habitat: P - Pickleweed; SG - Shadscale - gray molly; SGG - Shadscale - gray molly - greasewood; G - Greasewood; SB - Shadscale - budsage (dominant *Chrysothamnus* rabbit brush); S - Great Basin Sagebrush (*Artemisia tridentata*); VD - Vegetated dunes; JB - Juniper brush; MB - Mixed Brush
- (15) No Traps: Number of traps in each line minus number inoperative or ineffective.

Figure 4. List of code symbols on back of field and laboratory data sheet

ZOO NOTIC INFECTIONS TRANSMISSIBLE TO MAN

1. TULAREMIA (Francisella tularensis)

a. Background

Studies of F. tularensis in nature continue as the single representative of the once broad program in zoonotic research at DPG. In general, evidence of antibody activity in rodents and lagomorphs is characterized by low values, while it is much higher in carnivores. Serodiagnostic testing of livestock often reveals rather high levels of tularemia antibodies.

The passive hemagglutination test technique, using the highly refined lipopolysaccharide antigen, was further refined during the present reporting period.

b. Objectives

(1) To collect and test serum samples from rodents, jack-rabbits, livestock (sheep and cattle), wild horses, carnivores and other wildlife species, to determine tularemia activity in nature as it may relate to past testing activities at DPG and to detect epizootics of potential importance to humans

(2) To develop and refine techniques for testing

(3) To maintain an inflow of information on the current status of zoonotic infections in nature

(4) To maintain liaison with farmers and stockmen in the area for a source of locally maintained animals to sample for establishing baseline values

(5) To coordinate activities with public health and state agriculture officials and local mosquito-abatement districts

(6) To maintain the competency of the Environmental and Ecology Branch

c. Accomplishments

The relative densities of the three most common rodents (Amospermophilus leucurus, Dipodomys ordii and Peromyscus maniculatus) and other rodent species are shown in Figures B-1 to B-15 (Appendix B). The rodent densities are expressed as numbers per captures per 100 traps set. The results are combined for each year and are separated

for each species having sera positive for F. tularensis (Table 1). Species of rodents other than the three listed above also include those species not having positive serum samples. Serodiagnostic data for jackrabbits are tabulated in the same table. In Table 2, these data are arranged to show positive results by area. Absolute numbers of captures are not provided, because a quota was established for each area (between 30 and 60), and a required number was collected each quarter. In 1974, '75 and '76, serum samples from 1,774, 1,157 and 519 rodents; and 241, 140 and 63 jackrabbits, respectively, were tested for F. tularensis (Tables 1 and 2). Thirty-seven serum samples from carnivores were tested during the period (Table 3). Livestock sampling conducted in the spring and fall is described in detail below, horse serum samples were taken from a Bureau of Land Management (BLM) round-up, road kills and a die-off of horses in July 1976. Additional sera were collected from two antelopes.

Rodents, Jackrabbits, Carnivores and Antelope

Levels of recovery of antibodies from rodents remained fairly constant for the 3 years, 1974 through 1976 (overall percent 1.0, 3.1 and 2.7 respectively). In Table 1, Peromyscus crinitus and Perognathus flavus had the highest proportion of specimens that were positive among animals collected in moderate abundance. A. leucurus, Dipodomys ordii and P. maniculatus, the rodents most abundant and widely distributed, had fairly low rates of antibody response; P. maniculatus responded slightly higher. Lepus californicus had quite low antibody levels consistent with previous year findings at DPG. Two antelope (Antilocapra americana) were tested; one was positive with a high antibody titer.

Dugway Valley (where relatively more animals were captured), Dugway Mountain, Wendover and Gold Hill had the largest number of positive rodents (Table 2). During the 3 years, every area from which collections were made (except Condie) yielded one or more positive animals. This suggests that F. tularensis is widespread in the vicinity of DPG.

Eight of 11 Perognathus longimembris captured at Wendover account for the high, seropositive rate at this collecting site. The high frequency of tularemia in this infrequently encountered species is not understood. The F. tularensis organism, while widely distributed in the Bonneville Basin, seems restricted in many cases and limited to restricted foci.

Recovery of F. tularensis antibodies from 37 carnivores (Table 3) continued at the uniformly high rate of nearly 22 percent during 1974, '75 and '76, as had been reported previously. Four

Vulpes macrotis were negative,¹ while 20 to 30 percent of Canis latrans, Lynx rufus and Taxidia taxus were positive.

¹Only one of 21 V. macrotis was positive in 1969. In 1972, studies revealed lower development of antibodies to experimental infection in V. macrotis than with other carnivores.

Table 1 . Percent Species of Rodents and Jackrabbits by Species from All Areas With Antibodies to F. tularensis.

DATE		A1	Do	Dm	Pf	P1	N1	Rm	Pc	Pm	Pt	All spp. Rodents	Lc ^a
Year	Qtr												
74	1	0.0	0.0	--	--	--	--	--	--	0.0	--	0.0	3.2
	2	0.0	0.0	0.0	0.0	--	0.0	--	0.0	0.8	0.0	0.5	0.0
	3	0.0	1.5	0.0	4.8	--	0.0	--	7.7	0.0	--	1.3	2.3
	4	4.1	0.8	0.0	5.9	--	0.0	--	28.6	2.0	--	1.9	0.0
Percent 74		1.4	0.7	0.0	3.3	--	0.0	--	8.6	0.9	0.0	1.9	0.8
Total Exam.		146	590	46	61	0	4	0	35	645	6	1774	241
75	1	0.0	0.0	0.0	--	--	--	--	--	7.7	--	2.0	0.0
	2	0.0	1.1	--	20.0	72.7	50.0	100.0	33.3	6.9	0.0	5.3	1.9
	3	0.0	0.0	0.0	--	--	0.0	--	0.0	6.3	--	1.2	0.0
	4	0.0	0.8	0.0	33.3	--	0.0	--	42.9	1.3	0.0	1.6	0.0
Percent 75		0.0	0.7	0	26.0	72.7	5.3	100.0	35.7	5.4	0.0	3.1	0.7
Total Exam.		100	668	47	8	11	19	2	14	279	9	1157	140
76	1	--	--	--	--	--	--	--	--	--	--	--	--
	2	0.0	0.0	0.0	--	--	0.0	--	--	0.0	--	0.0	0.0
	3	0.0	0.0	0.0	9.5	--	0.0	--	--	0.0	--	2.1	0.0
	4	0.0	1.0	3.2	0	--	0.0	--	--	13.7	0.0	2.9	0.0
	All	0.0	0.7	2.3	7.7	--	0.0	--	--	7.1	--	2.7	0.0
Total Exam.		71	272	43	26	0	7	0	0	99	1	519	63

^a See Figure 4 for species indicated by initials.

Table 2. Areas with Rodents or Lagomorphs With Antibodies to *Francisella tularensis*

Location	Quarter												Total
	1974				1975				1976				
	1	2	3	4	1	2	3	4	1	2	3	4	
Granite Mt.	0/0	0/0	0/0	0/0	0/-	0/-	-	1/-	-	-	-	0/0	1/0
Camelbk. Mt.	0/0	1/0	0/0	0/0	0/0	2/0	1/-	0/-	-	-	0/-	0/0	4/0
Dugway Valley	0/0	1/0	0/1	0/0	0/0	5/0	0/-	0/0	-/0	-/0	0/0	1/0	7/1
Govt. Creek	-/0	0/0	0/0	1/0	-	1/0	0/-	1/0	-	-	-	0/-	3/0
S. Cedar Mt.	-	0/0	0/0	0/0	-	1/0	1/-	0/0	-	-	-	0/0	2/0
W. Cedar Mt.	-	0/0	0/0	0/0	-	1/0	0/-	1/0	-	-	-	1/0	3/0
Orr Springs											2/0		2/0
Condie	-	0/0	0/0	0/0	-	0/0	-	0/0	-	-	-	0/0	0/0
Ibapah	-	1/0	0/0	0/0	-	0/0	-	0/0	-	-	-	0/0	1/0
Fish Springs	-	0/0	2/0	0/0	-	1/-	-	2/0	-	-	-	1/1	6/1
Dugway Mt.	-	0/0	2/0	2/0	-	1/0	-	0/0	-	-	-	2/0	7/0
Wendover	-	0/0	-	3/0	-	8/0	-	1/0	-	0/0	-	1/0	13/0
Gold Hill	-	0/0	-	4/0	-	6/0	-	1/0	-	0/0	-	2/0	13/0
Callao	-	0/0	-	0/0	-	1/1	-	0/0	-	-	-	1/1	2/2
Wildcat Mt.												1/0	1/0
Total	0/0	3/0	4/1	10/0	0/0	27/1	2/-	7/0	-/0	0/0	2/0	10/2	65/4

Table 3. Percent of Carnivores by Species from Granite Mountain, Cedar Mountains, Camelback Mountain and Government Creek

YEAR	QUARTER	C1	Tt	Lr	Vm	Ba ^a	Total	% pos
74	1	5/3		2/0	1/0		8/3	
	2						-	
	3	2/0					2/0	
	4	2/0	1/0				3/0	
1974 Total		9/3	1/0	2/0	1/0		13/3	23.1
75	1	10/1		2/2			12/3	
	2			1/0			1/0	
	3		1/0				1/0	
	4	1/1					1/1	
1975 Total		11/2	1/0	3/2			15/4	26.7
76	1		1/0	1/0	2/0	1/0	5/0	
	2		1/0			1/0	2/1	
	3							
	4		1/1		1/0		2/1	
1976 Total			3/1	1/0	3/0	2/0	9/2	22.2
3 Year Total		20/5	5/1	6/2	4/0	2/0	37/8	
								22.2
		25%	20%	30%	0%	0%		

^aBa = Basariscus astutus; See Figure 4 for other species indicated by initials.

Table 5. Collection of Blood Samples from Cattle by Date and Range, Spring and Fall 1974-1976

Herd	E. & E. No.	Grazing Range	DATE											
			1974				1975				1976			
			Spring		Fall		Spring		Fall		Spring		Fall	
			Date No.	Results ¹ TA HA MA	Date No.	Results ¹ TA HA MA	Date No.	Results ¹ TA HA MA	Date No.	Results ¹ TA HA MA	Date No.	Results ¹ TA HA MA	Date No.	Results ¹ TA HA MA
Olsen	30	Vernon	2/5 16	1	15/10 16	0	29/4 16	11	16/12 16	5	22/4 16	4	3/12 14	7
Hale	34	Skull Valley	19/4 14	0	11/11 16	0								
Bagley	28	Callao	6/4 16	2	29/11 16	0	12/4 16	6	19/11 16	9	9/4 16	10	15/11 16	8
Deseret	41	Skull Valley					13/5 16	8	9/12 16	2	15/4 16	9	11/11 16	7
Total Nos			46	3	48	0	48	25	48	16	48	23	46	22
Percent Pos				6.5		0		52.1		33.3		47.9		47.8

¹TA = Tube Agglutination; 1:20 or > positive for sheep 1:40 or > positive for cattle
 HA = Hemagglutination - using LPS antigen; tentatively 1:40 or > for all livestock
 MA = Microagglutination

²HA = Results tentative; screening only completed for fall data

Table 4. Results from Serologic Testing for Antibody to *Francisella tularensis* from Collections of Blood Samples from Sheep by Herd, Date and Range, Spring and Fall 1974-1976

Herd	Winter & (Spring E data No. Follow)	DATE											
		1974				1975				1976			
		Summer Range (Fall- date follow)	Spring No. Results ¹ Date Test	Fall No. Results ¹ Date Test	Spring No. Results ¹ Date Test	Fall No. Results ¹ Date Test	Spring No. Results ¹ Date Test	Fall No. Results ¹ Date Test	Spring No. Results ¹ Date Test	Fall No. Results ¹ Date Test	Spring No. Results ¹ Date Test	Fall No. Results ¹ Date Test	Spring No. Results ¹ Date Test
Staley	33 Dugway Mts	SE Coalville	3/5 16 1	28/7 16 DONE	13/5 16 2	5/12 16 10	8/5 16 5	20/12 16 3					
Agard	23 Gold Hill	Chalk Creek	9/5 16 0	22/11 15 1	10/5 16 4		9/5 16 5	8/11 16 3					
Etchevery	24 Caliao	Lost Creek	3/5 16 0	29/10 6 ² 1	24/4 16 1	11/11 16 14	28/4 16 3	24/11 16 2					
Deseret	11 Pilot Mtn	Cisco	26/4 16 1	5/12 16 3	28/4 16 2	15/12 16 6	21/4 16 7						
Deseret	9 Aragonite	Cisco	23/4 16 0	17/12 16 1	30/4 16 8	25/11 13 10	20/4 16 5	26/11 16 8					
Anschutz	2 Davis Mtn	NW Uintas	15/4 16 0	17/11 16 1	9/4 16 3	10/12 16 14	20/4 16 2	17/11 16 5					
Anschutz	1 Dugway Mts E	NW Uintas	15/4 16 0	16/11 16 1	11/4 16 4		22/4 16 4	17/11 16 4					
Anschutz	4 White Rock	NW Uintas	6/4 17 0	16/11 16 4	7/4 16 8	13/12 12 10	10/4 16 2	16/11 16 7					
Total Nos.			129 2	117 12	128 32	89 64	128 33	112 32					
Percent Pos.			1.6	10.3	25.0	71.9	25.8	28.6					

¹TA = Tube Agglutination; 1:20 or > positive for sheep; 1:40 or > positive for cattle
HA = Hemagglutination - using LPS antigen; tentatively 1:40 or > for all livestock

²Serum from 6 additional sheep not taken since they were dead; probably ate halogeton

³HA results tentative; subject to further consideration; screening only completed for Fall data

Table 5. Collection of Blood Samples from Cattle by Date and Range, Spring and Fall 1974-1976

Herd	E. & E. No.	Grazing Range	DATE											
			1974				1975				1976			
			Spring		Fall		Spring		Fall		Spring		Fall	
			Date No.	Results ¹ TA HA MA	Date No.	Results ¹ TA HA MA	Date No.	Results ¹ TA HA MA	Date No.	Results ¹ TA HA MA	Date No.	Results ² TA HA MA	Date No.	Results ² TA HA MA
Olsen	30	Vernon	2/5 16	1	15/10 16	0	29/4 16	11	16/12 16	5	22/4 16	4	3/12 14	7
Hale	34	Skull Valley	19/4 14	0	11/11 16	0								
Bagley	28	Callao	6/4 16	2	29/11 16	0	12/4 16	6	19/11 16	9	9/4 16	10	15/11 16	8
Deseret	41	Skull Valley					13/5 16	8	9/12 16	2	15/4 16	9	11/11 16	7
Total Nos			46	3	48	0	48	25	48	16	48	23	46	22
Percent Pos				6.5		0		52.1		33.3		47.9		47.8

¹TA = Tube Agglutination; 1:20 or > positive for sheep 1:40 or > positive for cattle
 HA = Hemagglutination - using LPS antigen; tentatively 1:40 or > for all livestock
 MA = Microagglutination

²HA = Results tentative; screening only completed for fall data

c. Accomplishments

A total of 113 elk sera and 100 deer sera were tested 7 June 1976 and 2 December 1976. No deer sera were positive, but 57 of the elk sera were positive at titers varying from 1:20 to 1:320. In exchange for this information, E & E Branch received data regarding the collection of the elk and deer specimens. The elk were captured in pens and released on the Hardware Ranch, near Logan, Utah. Deer were captured with tranquilizer darts in Utah County, Utah. Valuable and recently published information was received on development of tranquilizer-loaded lead ammunition from the Soviet Union, as well as information on techniques of collection of large wildlife specimens.

4. Q FEVER (Coxiella burnetii)

a. Background

The recovery of Q fever antibodies from serum samples from wildlife and livestock collected around DPG has been constant for 12 years, with minor variations from time to time. A stable reservoir seems to exist around DPG. Highest detectable activity was observed between 1958 and 1960. Over the years, diagnostic tests for evidence of antibody activity have become refined. Distribution of Q fever has always been highly variable. There has been a marked difference in activity between wildlife and livestock.

b. Objective

Complement fixation (CF) testing has been discontinued for the time being.

c. Accomplishment

No sera were tested after 1975. The presence of antibodies in small rodents and jackrabbits in 1975 is shown in Table 7.

5. TECHNOLOGICAL LABORATORY STUDIES

The hemagglutination test was developed for testing wildlife, livestock and human sera for the presence of antibodies to Francisella tularensis. The development of this test was reported in the 1974 progress report, Chapter IV, pp. 89-94, and Appendix B. Since then, Standing Operating Procedure (SOP) 99 has been prepared (July 1975), and a first revision has been submitted. Changes in the revision have provided for use of less antigen in preparing sensitized cells and for tenfold dilution of serum samples.

Table 6. Results of Serologic Testing for *Francisella tularensis* Antibody in Horses, 8 October 1975 and 5 July 1976

Near English Village 8 October 1975		
Number Tested	Results ¹ (HA) Positive	Percent Positive
16	7	43.8
Orr Springs 5 July 1976		
Number Tested	Results ¹ (HA) Positive	Percent Positive
8	2	25.0

^aTentatively 1:40 or more for all livestock until confirmatory tests are completed.

Table 7. Complement-Fixing Q fever Antibodies, Rodents and *Lepus californicus*, During January Through July 1975.

HOST SPECIES	NUMBER POSITIVE	LOCALITY
<i>Ammospermophilus leucurus</i>	1	Wendover
<i>Dipodomys ordii</i>	4	1 Wendover, 2 Fish Springs, 1 West Cedar Mountain
<i>Perognathus parvus</i>	1	Iosepa
<i>Peromyscus maniculatus</i>	5	1 Gold Hill, 3 Iosepa, 1 Condie
<i>Neotoma lepida</i>	1	Dugway Mountain
<i>Lepus californicus</i>	2	Iosepa

The microagglutination test is being developed to replace the tube agglutination test (which uses more sample and reagent). SOP 94 is being prepared and is now in rough draft form but not yet submitted because of difficulties in perfecting the test.

In 1975, new serologic reagents (including hemolysin, complement and antigens) were standardized for Q-fever (C. burnetii) studies.

ECOLOGICAL TOXICOLOGY

1. BACKGROUND

The following study is part of our continuing effort to provide adequate technology for evaluating the environmental impact and danger to livestock when organic phosphate chemicals are used.

Because nerve agents and related organophosphorus insecticides are cholinesterase blocking agents, efforts have been made to establish the baseline levels of acetylcholinesterase (AChE) in the blood of cattle, sheep and selected leporids and rodents. Samples are taken from a wide area, and sampling is usually limited to twice yearly. Consequently, at the present level of effort, this semiannual sampling does not provide a system to detect nerve agents or insecticide exposure. However, this procedure can be used to evaluate the environmental impact and damage to livestock resulting from known or suspected exposures.

2. OBJECTIVES

- a. To determine baseline AChE levels in jackrabbits, selected rodents and livestock
- b. To determine confidence intervals and to perform relevant statistical tests
- c. To evaluate biological methods of detecting agents

3. ACCOMPLISHMENTS

a. Wildlife AChE Baseline Data

The toxicological surveillance data (Table 8) are arranged so that the wildlife species are presented in the order of phylogenetic relationship and subdivided by geographical areas, beginning with the westernmost and moving east (Figure 1, page 4, 1973 Annual Summary). The area included in this study is about 90 by 110 miles.

There seems to be no seasonal variation in the AChE levels in wildlife, but several years will be required for confirmation. The data from each species have simply been pooled (Table 8).

The means in Table 8 are used as the baseline AChE values. The confidence interval becomes quite small when enough data are pooled, as indicated, but the standard deviation remains relatively high (above 20 percent of the mean). Thus, it seems doubtful that a value of the mean less than 30 percent below the baseline value could be considered suspicious, and then only when accompanied by a

small confidence interval. Repeated sampling, however, is required to fully establish the validity of any piece of evidence.

b. Livestock AChE Baseline Data

Livestock herds were sampled at locations indicated on the map (Figure 2, page 10, 1973 Annual Summary). Mean levels of AChE activity for sheep and cattle are reported for 4 years beginning in the Fall of 1970. Cattle generally have higher AChE levels in the Spring than in the Fall. A seasonal effect is also seen in the sheep data, but the differences are smaller. The higher spring AChE values may be caused by remaining winter adaptation, which results in a higher metabolic rate for many animals. Combined data are presented in Table 9.

4. SUMMARY

Except for the unusual Fall and Spring cattle data and the spring-to-fall differences, variations from herd to herd and year to year are less than 10 percent from the baseline values and do not appear to be significant.

Baseline AChE levels are reported for wildlife species during the past 2 years and livestock over the past 4 years. Most of the wildlife data variation stays within 20 percent of the established mean, and there appears to be no long-term toxicological effect other than the possible exception of deer mouse populations at Gold Hill. Reduced AChE levels were found during only two seasons. Livestock data showed a similar lack of significant variation. The limited scope of the present semiannual sampling effort is discussed with reference to the detection of exposure incidents. Further work is needed to establish dose response in wildlife and to provide more information concerning normal baseline variation.

Table 8. Acetylcholinesterase Levels in Wildlife

Species	Total Sample Size	Mean	Confidence Interval	Standard Deviation	Percent Deviation from the Mean
<u>Ammospermophilus leucurus</u>	61	61.7	+ 3.5	14.1	23%
<u>Dipodomys ordii</u>	516	64.5	+ 1.1	13.3	21%
<u>Peromyscus maniculatus</u>	549	47.1	+ 1.0	11.7	25%
<u>Lepus californicus</u>	218	21.5	+ 0.6	4.2	20%

Table 9. Acetylcholinesterase Levels in Livestock

	Total Sample Size	Mean	Confidence Interval	Standard Deviation	Percent Deviation from the Mean
<u>SHEEP</u>					
Fall	471	95.0	+1.2	13.7	14%
Spring	502	100.0	+1.2	13.6	14%
<u>CATTLE</u>					
Fall	171	234	+6.8	45.5	19%
Spring	123	278	+6.9	39.1	14%

ENVIRONMENTAL IMPACT EVALUATION AT DUGWAY PROVING GROUND

1. BACKGROUND

Since the enactment of the National Environmental Policy Act (NEPA) in 1969, evaluation of proposed projects for potential adverse impact on the environment is required. When an assessment identifies adverse impact, mitigating or alternative procedures are sought.

2. OBJECTIVES

At DPG, all projects are evaluated for their potential impact on the environment. Projects of a type not previously assessed and documented to fulfill NEPA requirements are considered for preparation of an Environmental Impact Assessment (EIA). All other actions are addressed in a Conscientious Mental Evaluation (CME) or the Installation Environmental Impact Assessment (IEIA).

3. ACCOMPLISHMENTS

a. Installation Environmental Impact Assessment (IEIA)

The IEIA, a massive document, assesses the routine operation of DPG and is updated semiannually.

b. Pesticide Program at DPG

The pesticide program at DPG was assessed in August 1975. Subsequent changes in procedures have been minor and were dealt with in the IEIA.

c. Recreation Vehicles

An assessment on the establishment of a recreation vehicle area on DPG was prepared in May 1976. A mobilization designation officer, who is a soil scientist, assisted DPG in the preparation of this EIA. A regulation based on the EIA is pending.

d. Pistol Range

A new pistol range was proposed for DPG in late 1976. The environmental impact of the construction and operation of this range was addressed in a CME in October 1976.

e. Ranger Battalion Exercise

Annually, a battalion of Rangers conducts a 3-day training exercise at DPG. Training consists of parachuting onto the objective and engaging the opposing forces in a brief small-arms battle. The environmental impact of this exercise was addressed in November 1976.

f. Animal Trapping at Tower Grid and West Granite

Beginning in 1975, demilitarization commenced on hardware containing nerve agent. EIAs for the demilitarization effort are discussed in Volume II. Hardware was stored at West Granite Area. Small amounts of leaking agent were suspected at Tower Grid holding area, where unidentified munitions were stored awaiting disposition. A preliminary rodent trapping and sentinel animal plan was activated to examine the situation in support of the EIAs. Live traps (251) for collecting small rodents were set around the perimeter of Tower Grid holding area for 3 days (20 to 22 August 1975). Additionally, three Peromyscus maniculatus from the laboratory were caged and placed at each of 12 sites along the fence. One mouse was removed each day for 3 days, and blood samples were taken. Thirty-seven wild rodents (mostly Dipodomys ordii and P. maniculatus) were taken (12.2 animals per 100 trap nights, indicating average density). AChE levels were average for both wild rodents and laboratory-reared P. maniculatus. Around the perimeter of West Granite demilitarization site, 150 live traps were placed for 2 days (3 to 4 September 1975). Twenty-one rodents collected (4.9 animals per 100 trap nights) indicated average density. AChE levels were average.

HORSE DEATHS

1. BACKGROUND

Numerous wild horses died during the week of 4 July 1976 in the Orr Springs area at DPG. A full account of the resulting investigation may be found in other documents^{1,2}; however, a brief summary follows.

The area in which these wild horses roam is rugged and arid. Before 4 July 1976, the weather had been unusually hot and dry; no precipitation had been recorded since 21 May 76. With the depletion of the normal water supply and an increase in horse population, competition for the remaining water was greatly amplified.

The normal water hole at Orr Springs had been altered by the Bureau of Land Management (BLM); water was piped from its natural reservoir to a trough surrounded by stacks of creosoted poles and low marking stakes with flags (Figure 5).

2. OBJECTIVE

To determine the cause of the sudden occurrence of sick, dying and dead horses, the investigation included but was not limited to necropsy, gross pathology, serology, microbiological and chemical analyses.

3. ACCOMPLISHMENTS

In addition to processing of specimens at DPG, other laboratories received and processed samples collected as listed in Table 10. No pathogens or toxic substances were connected with horse deaths. Pathological findings indicated severe dehydration. Symptoms include, extreme hemoconcentration, comatose behavior, emaciation and petechial hemorrhages on the surface of the brain. Details are presented in the reports.

¹Shoenfeld, F.J. (Utah State Veterinarian), 1976. Wild Horse losses, Orr Springs area, Dugway Proving Ground, Utah. Veterinary Services, U.S. Dept. Agri. 51 p. (Unnumbered printed document).

²U.S. Army Dugway Proving Ground, Investigations of Deaths of Horses at Orr Springs. Final Report. L.L. Salomon, et al. Sept 1976

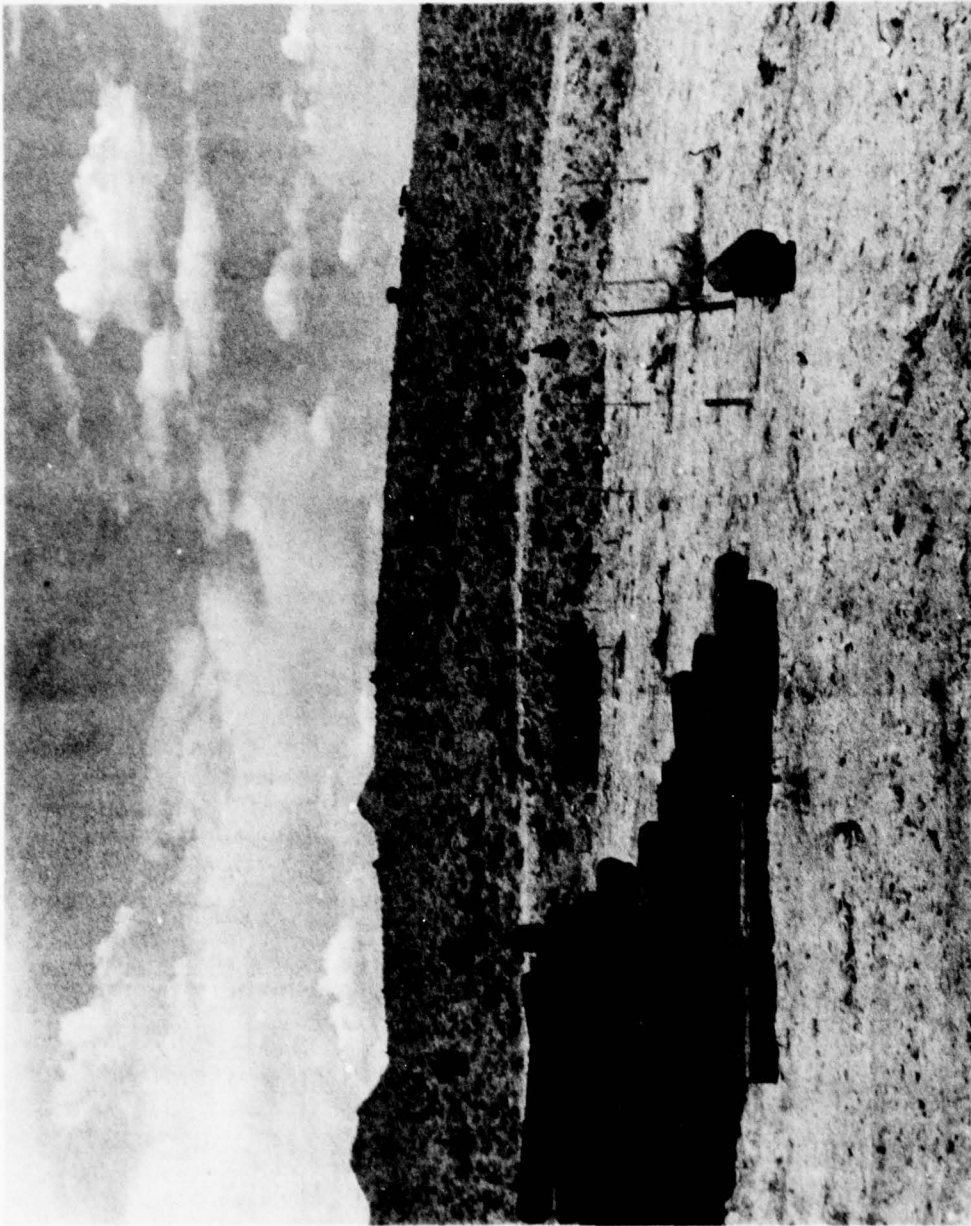


Figure 5. BLM wild horse watering trough at Orr Springs

Table 10. Disposition of Samples from Area Where Horses Uied

	Water	Soil	Plants	Ticks	Mosquitoes	Rodents	Tissue Equine	Sera Equine	Analysis Forage	Arbo-virology
Center for Disease Control										
U.S. Public Health Service							X			X
Natural Resources Laboratory										
Colorado State Univ									X	
Baker Lab & Chem Lab, Dugway, UT	X	X	X	X	X	X	X	X	X	X
Intermountain Lab							X	X		
Letterman Army Institute of Research							X	X		
Univ Montana, Biological Staff	X									
Utah State Div of Health	X	X					X	X		X
Univ of Utah Dept of Biology							X	X		
Salt Lake County Mosquito Abatement District										X

There was no evidence of horses using the modified water supplies provided by BLM. An example of how the horses attempted to obtain water is shown in Figure 6. Note the moist soil that had been dug in an attempt to reach a natural source of water. The amount of water that normally appeared in the area shown was reduced because of the alteration work done by BLM when the trough was installed. Furthermore, most deceased horses were in tight groups concentrated in spots that had earlier furnished water.

In an attempt to alleviate the water shortage for the remaining weak and dying horses, DPG personnel hauled water to tanks recessed into and level with the ground. This water supply also was unused; however, horses were observed drinking spring water from natural holes filled and enlarged by DPG personnel (Figure 7).

A meeting of DPG scientists, BLM officials and representatives from a number of independent laboratories was convened at DPG by Dr. Schoenfeld, Utah State Veterinarian to consider the above facts. It was concluded that most of the wild horses died of dehydration, though some died of overhydration when water was again made available.



Figure 6. Wild horses attempting to obtain water from altered watering hole



Figure 7. Wild horses drinking from hole artificially filled with water

IN-HOUSE LABORATORY INDEPENDENT RESEARCH

ARBOVIROLOGY PROJECTS, 1974-1976

1. BACKGROUND

Serologic surveys of native animals in western Utah in the early 1960s indicated possible arbovirus activity. Follow-up isolation studies, which began in 1965, continue to the present. The discovery of Venezuelan Equine Encephalitis (VEE) in the southern United States in 1972 prompted the addition of southern Utah as a surveillance area.

2. OBJECTIVE

To continue surveillance for arboviruses in western Utah and to survey the southern Utah area for possible intrusion of viruses of agricultural and public health interest.

3. ACCOMPLISHMENTS

In western Utah during 1974 and 1975, a total of 33,978 insects collected for arbovirus studies were segregated into 371 pools and assayed in suckling mice. Of the 55 isolations, 54 were California Group (CAL) and one was Lokern Virus. The majority of CAL viruses were from Aedes dorsalis, including 48 from Blue Lake, three from Callao and two from Fish Springs. The Lokern virus was from Culicoides variipennis from Callao.

Insects were also collected in southern Utah during 1974 and 1975. A total of 12,222 specimens in 188 pools were assayed for arboviruses. Seven isolates were obtained, including four western equine encephalitis, two Main Drain and one Anopheles A Group virus.

During 1975, the isolation of California encephalitis virus from laboratory-reared Aedes dorsalis, which were collected as larvae at Blue Lake, Utah, was significant since it demonstrated transovarian transmission and suggested a possible mode for overwintering of the virus.

In 1976, field collections were curtailed because of the diversion of manpower to the study of horse deaths at DPG. No collections were made in southern Utah, and insects were collected only in August and September in western Utah.

Publications which resulted from these studies during 1974 to 1976 are listed in Appendix A.

TULAREMIA

1. BACKGROUND

Since 1951 at DPG efforts have produced widely recognized studies of native biota, with emphasis on zoonoses. Of all zoonoses around DPG, the arboviruses and tularemia have been recovered most frequently and continuously. Numerous publications on tularemia and its occurrence in nature have been published. Some attempts were made to summarize the efforts,^{1,2} but these emphasized the work of particular interest to each respective author.

2. OBJECTIVES

To conduct library research with the immediate objective of evaluating work on tularemia at DPG and compiling the findings into a single reference, which will serve as useful source material on every aspect of tularemia in Utah. A long-range objective is to use the findings to guide future research on tularemia in nature around DPG. This research will include laboratory and field work to resolve unanswered questions on the occurrence of the organism in nature and to discover the true reservoir.

¹U.S. Army Dugway Proving Ground, Dugway, Utah
A Review of Tularemia by Gebhardt, L.P. and B. Thorpe,
Prepared by University of Utah
Contract No. DA-42-007-403-CML-427 (R)
12 Jun 1962

²U.S. Army Dugway Proving Ground, Dugway, Utah.
Summary Status Report on Pasteurella tularensis.
Prepared by University of Utah
Special Report No. 88U (R).
15 Dec 1962.

ECOLOGY OF ANTHRAX

1. BACKGROUND

In August 1975, the Utah State Veterinarian, Dr. James Schoenfeld, received reports of unexplained cattle deaths in Rush Valley, Tooele County, Utah. The area is approximately 25 air miles northeast of DPG. When the cause of death was later diagnosed as anthrax, Dr. Schoenfeld contacted DPG for assistance in investigating the epidemiology of the outbreak. A microbiologist experienced in anthrax epidemiology was assigned to head the Epidemiological Investigation. When another anthrax outbreak occurred in cattle later in 1975 in Davis County, Utah, approximately 35 miles northwest of Salt Lake City, similar support was provided to Utah State officials.

2. OBJECTIVE

To assist state authorities in determining the epidemiology of two outbreaks of bovine anthrax.

3. ACCOMPLISHMENTS

These cooperative studies resulted in finding that the outbreaks of bovine anthrax in Utah undoubtedly originated from the soils of previously infected pasturelands and were fostered by altered conditions in climate occurring in 1975 (a spring cooler and wetter than normal, followed by a summer drier and hotter than normal). An additional benefit of the study was a new, more sensitive procedure for extracting anthrax spores from soils. Later refinements increased the sensitivity of this technique still further by growing the recovered spores directly on membrane filters. Dissemination of information concerning these improvements in recovery of anthrax spores from environmental samples led to a request to the principal developers of the technique to rewrite the chapter on anthrax in the new edition of the American Public Health Association's "Diagnostic Procedures for Bacterial, Mycotic and Parasitic Infections".

PREINSTALLATION HISTORY

1. BACKGROUND

The Federal Antiquities Act of 1906 (34 Stat. 225, 16 USC 431-433) and subsequent legislation require the commanders of federal installations to identify historical resources in and adjacent to their installations. The obvious historical resources on and adjacent to DPG have been reported in the Installation Environmental and Impact Assessment (see Volume II).

2. OBJECTIVE

Historians, long-time residents and historical documents will be consulted for information. Sites identified by these sources will be visited. If any appear to be of historical significance, federal and state historians will be invited to examine them. The final study will be incorporated into the Installation Environmental Impact Assessment.

3. ACCOMPLISHMENTS

The project commenced in 1975 and is still in progress. Surveyor plats dating from the 1850's to the present have been examined, and old roads, buildings and other man-made structures have been recorded. Old documents regarding the Pony Express route, the Lincoln Highway and mining activities have also been researched. Aerial photographs dating from the 1950's have been consulted to help clarify the location of old wagon roads, the Lincoln Highway and man-made structures. More library work will be required to verify leads received from long-term residents in the area and the people will have to be polled regarding their knowledge of the preinstallation history of DPG.

FLEA STUDIES

1. BACKGROUND

Studies on fleas have continued from 1963 to the present. Earlier studies on the biology of fleas were directed particularly to those species important in the transmission of plague.

2. OBJECTIVE

To continue studies on fleas, with emphasis on taxonomy. A co-operative effort is underway on a project entitled "Fleas of North America: Ecology and Systematics." The principal investigator is Dr. Vernon J. Tipton, Center for Health and Environmental Studies, Brigham Young University, Provo, Utah 84601. The study is funded by the National Institutes of Health. An objective is for DPG personnel to be advisors on this project. Several projects involving DPG personnel and other contributing laboratories (Center for Disease Control, Fort Collins, Colorado 80522) are contemplated.

3. ACCOMPLISHMENTS

Instruction Kit in Medical Entomology

In 1975, the Entomological Society of America and Brigham Young University co-produced an instruction kit for teaching medical entomology. The kit contains 28 cassette lectures. The lectures average 40 minutes each. Two manuals and 219 color transparencies are included in each kit. The manuals contain lecture outlines, selected and general references, discussion questions and illustrations.

Dr. Harold E. Stark, E & E Branch, prepared the lecture on plague, including a 90-minute taped lecture, 20 pages of the manual and 15 color transparencies of diagrams and photographs.

Description of the Third-Instar Larva of *Monopsyllus wagneri*

This published article briefly reviews some problems involved with interpreting some characters of immature states of Family Ceratophyllidae (Siphonaptera). *Monopsyllus wagneri* from *Peromyscus maniculatus* captured in Colorado and Utah were reared in the laboratory (DPG and Ft. Collins), and third instar larvae were mounted, studied and described.

A revaluation of the *Hystrichopsylla occidentalis* group with
description of a new subspecies

Hystrichopsylla occidentalis was described by Holland in his Siphonaptera of Canada. Specimens were encountered which do not fit the descriptions provided by Holland. They are distributed from southern California throughout Idaho, Utah, Arizona and Colorado. Specimens were gathered from as many sources as possible, studied, separated and described. There are now three distinct populations of *H. occidentalis* which merit subspecies rank.

Fleas of New Mexico

This study has commenced with completion of a state list of 110 species and a key for these species.

PARATHION TOXICITY IN CATTLE

1. BACKGROUND

On 15 November 1975, an Erda, Utah, farmer dipped 180 of his cattle in a bath containing 1,600 ppm of parathion. Utah State Department of Agriculture officials request DPG assistance in the epidemiological investigation. Efforts to save the cattle were only partially successful. Only about 25 of the original 180 cows and calves survived.

Significant amounts of parathion (about 10 percent of the original dose) remained on skin surfaces after two decontamination attempts, resulting in considerable uncertainty as to what may be done to save organophosphorus-contaminated large animals in the future. Much of the difficulty lay in the fact that the animals were intractable, so the decontamination agents were probably not fully effective.

Rather than publish a simple case report with the uncertainties mentioned, it was desirable to undertake a small-scale laboratory study to develop a better decontamination method and to produce a more useful publication.

Guinea pigs were used as test animals, to simulate conditions under which cattle and other large animals might be decontaminated. Guinea pigs have relatively rigid bodies and, like cattle, are not prone to lick themselves extensively.

According to Monsanto and Wilber-Ellis Chemical Company literature, parathion rapidly penetrates the skin and is dangerous even without ingestion. This finding was supported by the general observation that organic materials like parathion, which show a favorable partition coefficient for lipids, penetrate biological membranes relatively rapidly.¹

2. OBJECTIVES

To search the literature for decontamination methods, to make further field observations and to test and develop better decontamination methods for large animals.

¹Davson, H., 1959. A Textbook of General Physiology. Little Brown and Co. Boston

3. ACCOMPLISHMENTS

A thorough literature search revealed that very little has been published relative to the surface decontamination of animals with parathion, and only one significant paper was discovered relative to ingested parathion. This paper described the feeding of activated charcoal as a remedy to affected cattle and sheep.¹

The surviving cattle were bled several times subsequent to the emergency treatment and cholinesterase levels were determined.

Laboratory experiments with guinea pigs are complete, and several alternative methods of decontamination have been disclosed. Briefly, the guinea pigs were made to swim in a container of 2,000 to 4,000 ppm parathion for 15 seconds, analogous to the dipping procedure used for cattle. They were allowed to dry. Then, in most instances, they were made to swim again, in various decontamination mixtures. In two cases, however, guinea pigs were sprayed with a special emulsifiable solvent containing 45 percent kerosene, 45 percent ERA (household detergent) and 10 percent isobutanol. After 10 minutes, the guinea pigs were hosed down with water (Emul-H₂O) or allowed to swim for 15 seconds in 1 percent Na₂CO₃ solution (Emul-CO₃).

In an earlier experiment, pieces of wool cloth were treated in much the same way as the guinea pigs. The results are summarized in Tables 11 and 12. Hypochlorite was not used in these experiments, because paraoxin (a highly toxic compound) was found on the skins of the Erda cattle treated with 2 percent hypochlorite. A preliminary experiment also showed that parathion spread on the surface of metal plates, is converted by hypochlorite into paraoxin with good yield (70 to 75 percent). Paraoxin is three to five times more toxic to mammals than is parathion, therefore oxidative methods of decontamination are to be avoided.

Two papers dealing with decontamination of cattle exposed to parathion dip have been prepared for publication in the Journal of Veterinary and Human Toxicology (See Appendix A).

¹Furr, A.A. and T.L. Carson. 1976. Therapeutic measures used in the treatment of organophosphorus insecticide toxosis in sheep. J. Vet. Tox. 17:122-124.

Table 11. Guinea Pigs Treated 2000 ppm with Parathion

Treatment	Av. ^a wt in grams	Av. ^a mg/kg hair	Percent control hair	Av. ^a mg/kg skin	Percent control skin	Av. ^a mg/kg fat	Percent control fat
Control (no decon)	525	4250	100.00	111.0	100.0	21.9	100.0
1 % Na ₂ CO ₃	558	2233	52.5	71.1	64.1	12.3	55.9
1 % S D S	676	207	4.8	3.1	2.8	0.96	4.4
1 % DSD-1% CO ₃	605	84	2.0	3.8	3.4	0.60	2.7
Kerosene	578	43	1.0	1.4	1.3	0.41	1.8
Emul - H ₂ O	606	52	1.2	2.1	1.9	0.44	2.0
Emul - CO ₃	595	57	1.3	0.76	0.69	0.49	2.2

^aAverages are taken from three animals

Table 12. Trials-of Decontaminants

Treatment	Guinea Pigs 2000 ppm		Guinea Pigs 4000 ppm		Wool Cloth 4000 ppm	
	Av. ^a amount in hair	Percent of control	Av amount in hair	Percent of control	Av amount	Percent of Control
Control	4250	100.0	6040	100.0	17,600	100.0
Na ₂ CO ₃	2230	52.5				
S D S	207	4.8				
S D S - CO ₃	84	2.0	950	16.0	1150	6.5
Kerosene	43	1.0	180	2.7	640	3.7
Emul - H ₂ O	52	1.2			620	3.6
Emul - CO ₂	57	1.3				

^amg/kg-summary of three trials

EMISSION OF VIRUSES FROM SEWAGE TREATMENT PLANT FACILITIES

1. BACKGROUND

This project continued a series of studies involving assessment and characterization of potentially hazardous aerosols in the environment. It was the first known attempt to isolate virus-laden aerosols from sewage-treatment facilities. The project was conducted in co-operation with the University of Michigan, School of Public Health.

2. OBJECTIVE

To examine the emission of various viruses into the atmosphere from both trickling-filter and activated-sludge sewage-treatment plants.

3. ACCOMPLISHMENTS

Two activated-sludge and two trickling-filter plants were studied. Coliphages from the aerosols were isolated, but no animal viruses were isolated. Using a ratio technique between coliphages and animal viruses in the water and coliphages in aerosols, it was determined that approximately 10^2 greater sampling sensitivity would be required. The use of coliphages as indicators of animal viruses emitted from these facilities was established. Three presentations were made at scientific meetings (one national), and two open literature publications resulted from this work (see Appendix A).

BIOLOGICAL AEROSOLS PRODUCED BY COMMUNAL SHOWER BATHING

1. BACKGROUND

The human skin is the habitat of many species of bacteria. Most of the skin inhabitants are either micrococci or corynebacteria. However, other groups of microbes colonize the skin from time to time. Members of the genus Staphylococcus, often found in the nares of the nose, can establish themselves on the skin. Certain strains of staphylococci are quite pathogenic and, if inhaled into the respiratory passages, may cause such diseases as tonsillitis, otitis, bronchitis and pneumonia. The jets of water striking the skin of the body during shower bathing were hypothesized to provide an aerosolizing mechanism for skin bacteria. Aerosols generated from people from different geological areas could pose a considerable public health problem.

2. OBJECTIVES

a. To determine how many bacteria are aerosolized during communal shower bathing.

b. To determine how many Staphylococcus aureus are aerosolized.

3. ACCOMPLISHMENTS

Shower-bathing studies were conducted on the gymnastic classes of two high schools and the varsity basketball team of a major university. Aerosol samples were collected and assayed for bacteria. The number of Staphylococcus aureus aerosolized was determined by differential diagnostic media and biochemical tests. It was concluded that measurable quantities of biological aerosols may be generated under such circumstances. Technical papers reporting on the studies have been prepared for publication in Public Health Reports and Science (see Appendix A).

TAXONOMY OF THE GYMNOASCACEAE

1. BACKGROUND

Fungi of the family Gymnoascaceae produce characteristic sexual fruiting structures and asexual spores known as aleuriospores or arthroaleuriospores. Among these fungi are several well-known pathogens, including the causal agents of histoplasmosis, North American blastomycosis, coccidioidomycosis and ringworm. Investigations by various researchers have demonstrated sexual states of several of the ringworm fungi, of the causal agents of histoplasmosis and North American blastomycosis, and found that they are Gymnoascaceae. Their relationships to one another and to other members of the family are not yet thoroughly traced or understood. Additionally, most of the pathogens have been shown to be heterothallic; that is, requiring two compatible strains of the fungus to produce the characteristic fruiting structure. Many fungi are homothallic (characteristic fruiting structures produced by one plant) or produce only in asexual states. Many of those producing only the asexual states have been confused with and misidentified as pathogens; for example, ringworm fungi and Coccidioides immitis (causal agent of "Valley Fever").

Understanding the biology and taxonomy of naturally occurring fungi has been fostered by continuing studies initiated in 1963. Widely recognized published works have resulted from these investigations.

2. OBJECTIVES

- a. To identify and more precisely define the members of this family of fungi and to clarify species now confused.
- b. To determine and describe new genera and species isolated during this study and to determine relationships of these new species to those already known.
- c. To spur the interest of other investigators in the determination of relationships through studies of apparently related fungi serologically as well as morphologically. To establish improved understanding of the nonpathogenic members of the fungus family with the pathogenic ones. (Improved understanding may provide the basis for a method of control of pathogenic species in natural habitats.)

3. ACCOMPLISHMENTS

Strains of fungi of this family are being isolated from as many substrate sources and geographical areas as possible. Sources include soils, dung of various animals, paper, organic debris, hair, feathers and other human and animal sources. Isolates have been received from India, England, Germany, Canada, Colombia and various areas of the United States.

APPENDIX A
PUBLICATIONS AND REPORTS

1. U.S. Army Reports (completed, submitted and printed)

a. U.S. Army, Dugway Proving Ground, Utah 84022. Ecology Studies in the Bonneville Basin of West Central Utah. Final Report. By K.L. Smart and staff, Annual Report, 1 Jan 1973 - 31 Dec 1973, DPG-FR-X100P, November 1976. UNCLASSIFIED

2. Oral Presentations at Scientific Meetings by Members of Environmental and Life Sciences Division

a. Intermountain Branch, American Society for Microbiology, Logan, UT. 20 March 1976. "Enhanced recovery of Bacillus anthracis spores from environmental samples (soils) by membrane filtration of suspensions treated with filter aid" by Rees, H.B.

b. International Northwestern Conference on Diseases in Nature Communicable to Man. 31st Annual Meeting. University of Utah, Salt Lake City, UT. 16 - 18 August 1976.

(1) "Isolations of Western encephalitis virus from southern Utah Culex tarsalis" by Elbel, R.E. and G.T. Crane.

(2) "California group virus from Aedes dorsalis adults reared from larvae collected at Blue Lake, Utah" by Crane, G.T. and R.E. Elbel.

(3) "An improved technique for recovering spores of Bacillus anthracis from environmental samples" by Rees, H.B., J.C. Spendlove, R.S. Frazer and M.A. Smith.

(4) "Epidemiology of bovine anthrax in Utah in 1975" by Smith, M.A., R.S. Frazer, A.G. Barbour, J.C. Spendlove and H.B. Rees

(5) "Tularemia: Its early history in Utah, its taxonomic status and the program of study at Dugway Proving Ground, past and present" by Stark, H.E.

(6) "Leptospirosis in beaver" by Adams, A.P. and D.C. Winters.

3. In Preparation

a. Campos, E.G. and H.E. Stark. A revaluation of the Hystrichopsylla occidentalis group with description of a new subspecies (Siphonaptera: Hystrichopsyllidae).

b. Rees, H.B. Invited as author for a chapter on "Animal Diseases Transmissible to Man" in the 6th edition of "Diagnostic Procedures for Bacterial, Mycotic and Parasitic Infections," American Public Health Association, New York. N.Y. 1978

4. Open Literature Publications - Submitted For Publication

- a. Adams, A.P., M. Garbett, A.T. Hereim and J.C. Spendlove. Biological aerosols Generated by Shower Bathing.
- b. Choules, G.L., W.C. Russell and F.J. Schoenfeld. Decontamination of cattle exposed to parathion dip. Veterinary and Human Toxicology.
- c. Crane, G.T. and R.E. Elbel. California encephalitis virus at Blue Lake, Tooele, County, Utah. Proc. Utah Mosq. Abate. Assn. 29:___.
- d. Crane, G.T. and R.E. Elbel. California group virus from Aedes dorsalis adults reared from larvae collected at Blue Lake, Utah. Proc. NW Mosq. & Vector Cont. Assn.
- e. Crane, G.T., R.E. Elbel and C.H. Calisher. Transovarian transmission of California encephalitis virus in the mosquito Aedes dorsalis at Blue Lake, Utah. Mosq. News
- f. Elbel, R.E., G.T. Crane, C.H. Calisher and D.B. Francy. Arbovirus isolations from insects collected in and near southwestern Utah. Proc. Utah Mosq. Abate. Assn. 29:___.
- g. Elbel, R.E. and G.T. Crane. Isolation of Western encephalitis virus from southern Utah Culex tarsalis. Proc. NW Mosq. & Vector Cont. Assn.
- h. Elbel, R.E., G.T. Crane and C.H. Calisher. Arbovirus isolations from southwestern Utah and northwestern Arizona insects, 1972-1975. Mosq. News.
- i. Orr, G. F. 1978. The genus Pseudogymnoascus. Mycotaxon (in press).
- j. Roy, K., G.F. Orr and G.R. Ghosh. The genus Rollandina. Kavaka.

5. Open Literature Publications

- a. Crane, G.T., D.B. Francy, R.E. Elbel and K.L. Smart. 1974. Bunyamwera group and other viruses from Bonneville Basin, Utah, 1972. Proc. Utah. Mosq. Abate. Assn. 26:31.
- b. Crane, G.T., R.E. Elbel and K.L. Smart. 1975. Arbovirus isolations from the Bonneville Basin of western Utah, 1973. Proc. Utah Mosq. Abate. Assn. 27:26.

c. Crane, G.T., R.E. Elbel and K.L. Smart. 1976. Arbovirus isolations from Blue Lake, Callao and Fish Springs, Utah 1974. *Proc. Utah Mosq. Abate. Assn.* 28:10.

d. Elbel, R. E., G. T. Crane and K. L. Smart. 1975. Arbovirus isolations from southern Utah insects, 1973. *Proc. Utah Mosq. Abat. Assn.* 27:26.

e. Elbel, R. E., G. T. Crane and K. L. Smart. 1976. Arbovirus isolations from Beaver Dam, Arizona 1974. *Proc. Utah Mosq. Abat. Assn.* 28:11.

f. Fannin, K. F., J. C. Spendlove, K. W. Cochran and J. J. Gannon. 1976. Airborne coliphages from wastewater treatment facilities. *J. Appl. and Envir. Micro.* 31:705-710.

g. Fannin, K. F., J. J. Gannon, K. W. Cochran, and J. C. Spendlove. 1977. Field Studies on coliphages and coliforms as indicators of airborne animal viral contaminations from wastewater treatment facilities. *Water Res.* 11:181-188.

h. Orr, G. F., G. R. Ghosh and K. Roy. 1977. The genera *Gymnascella*, *Arachniotus* and *Pseudoarachniotus*. *Mycologia* 69: 126-163.

i. Barry, J., M. Tyskowsky, Jr., G. F. Orr, R. B. Eckblad, R. L. Marsalis and W. M. Ciesta. 1976. Impaction of Zectran particles on Spruce Budworm larvae: A field experiment. Pesticide Spray Application, Behavior and Assessment: Workshop Proceedings, USDA Forest Service General Technical Report PSW-15/1976. P40-47

j. Orr, G. F. 1976. *Kuehniella*, a new genus of the Gymnoascaceae. *Mycotaxon* 4: 171-178.

k. Orr, G. F. 1977. Another genus of Gymnoascaceae with swellings on peridial septa. *Mycotaxon* 5:283-290.

l. Orr, G. F., K. Roy, and G. R. Ghosh. 1977. *Gymnoascoideus*, a new genus of the Gymnoascaceae. *Mycotaxon* 5:459-569.

m. Orr, G. F. 1977. A new species of *Gymnoascus*. *Mycotaxon* 5:470-474.

n. Orr, G. F., W. C. Tippets, and D. S. Thorne. 1977. Effects of several wetting agents on the viability of an arthroaleuriosporous fungus. *Bull. Torrey Bot. Club* 194:25-28.

o. Orr, G. F., 1977. New Gymnoascaceae. *Mycotaxon* 6:283-290.

p. Orr, G. F., 1977. Survival of arthroaleuriospore-producing fungi in mice. *Sabouraudia* 15: 243-249.

q. Rees, H. B., Jr. et al. 1977. Epidemiological and Laboratory Investigations of Bovine Anthrax in Two Utah Counties in 1973. *Publ: Hlth. Rpts.*, 92: 176-185.

r. Stolk, A. C. and G. F. Orr. 1974. *Sagenoma*, a new genus of Eurotiaceae. *Mycologia* 66: 676-680.

s. Stark, H. E., E. G. Campos and R. E. Elbel 1976. Description of the third-instar larva of *Monopsyllus wagneri* (Baker) (Siphonaptera: Ceratophyllidae). *J. Med. Ent.* 13: 107-111.

APPENDIX B
DENSITY DISTRIBUTION
OF
RODENT SPECIES
BY
AREA AND YEAR
1974 THRU 1976

NOTE: All rodent species include all species listed in Figure 4. Predominant rodent species were Ammospermophilus leucurus (Code: Al), Dipodomys ordii ssp (Code: Dm) and Peromyscus maniculatus (Code: Pm) as revealed by capture per 100 traps set.

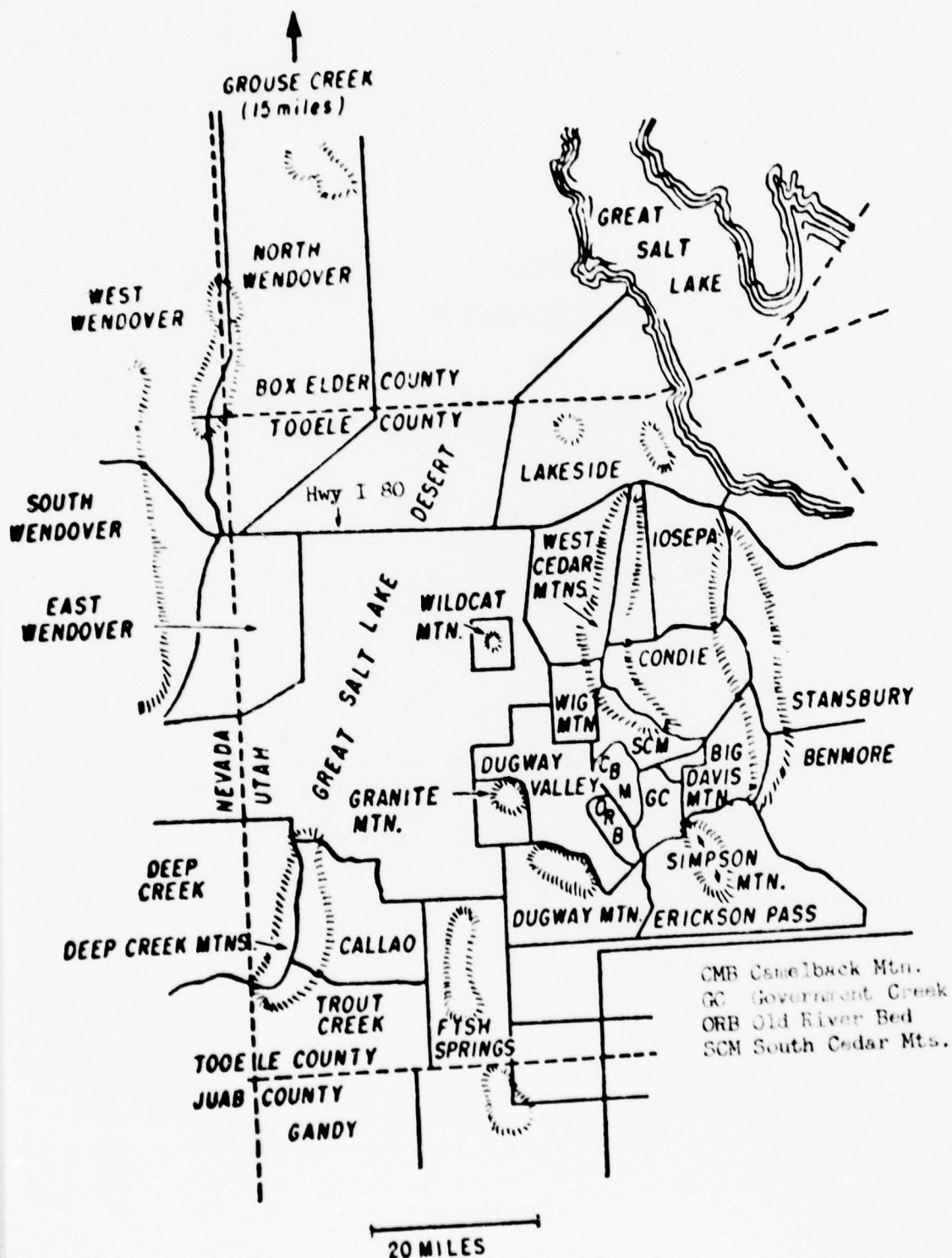


Figure B-1. Collecting areas

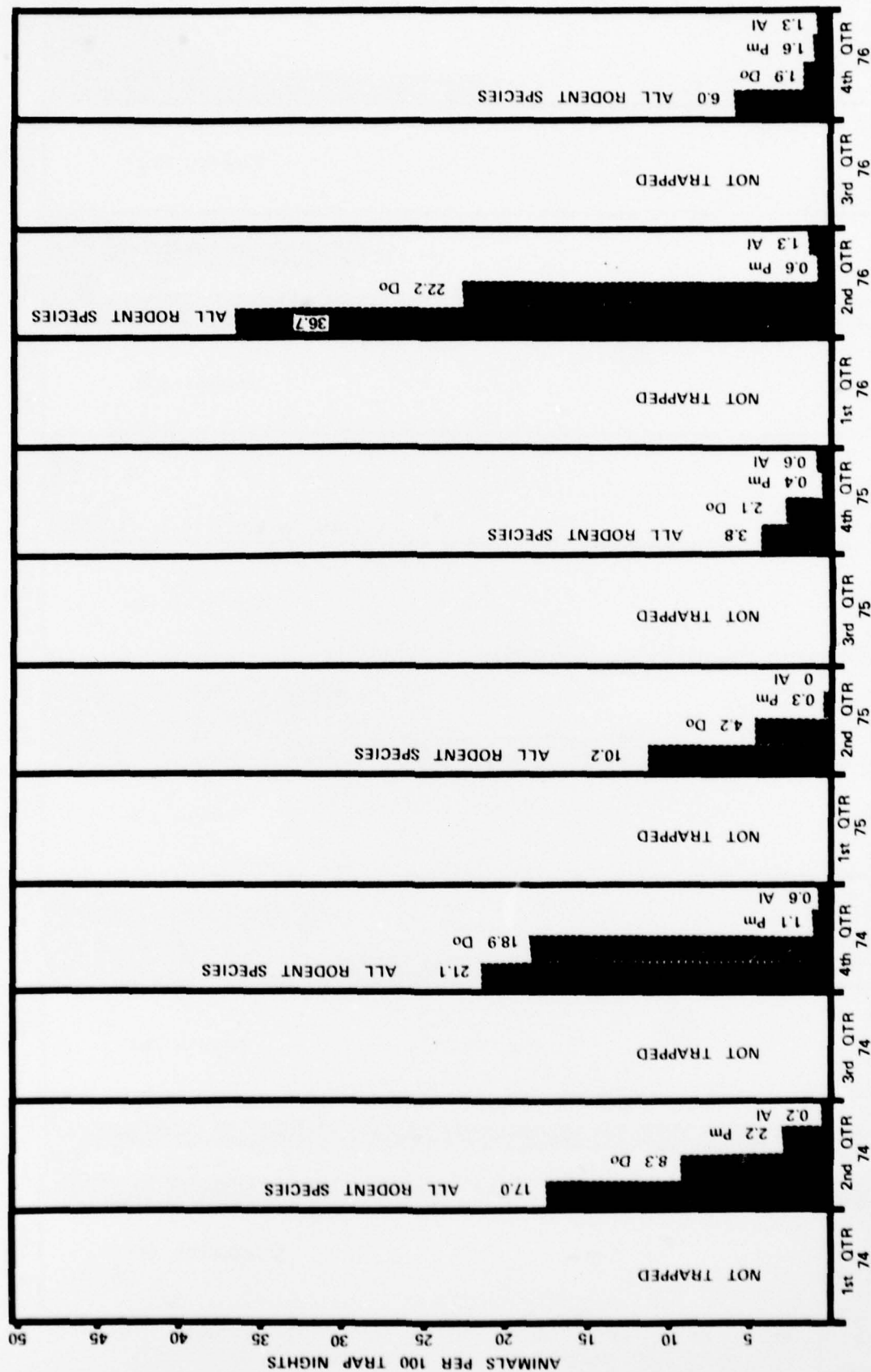


Figure B-2. Density distribution of rodent species collected in the Wendover area

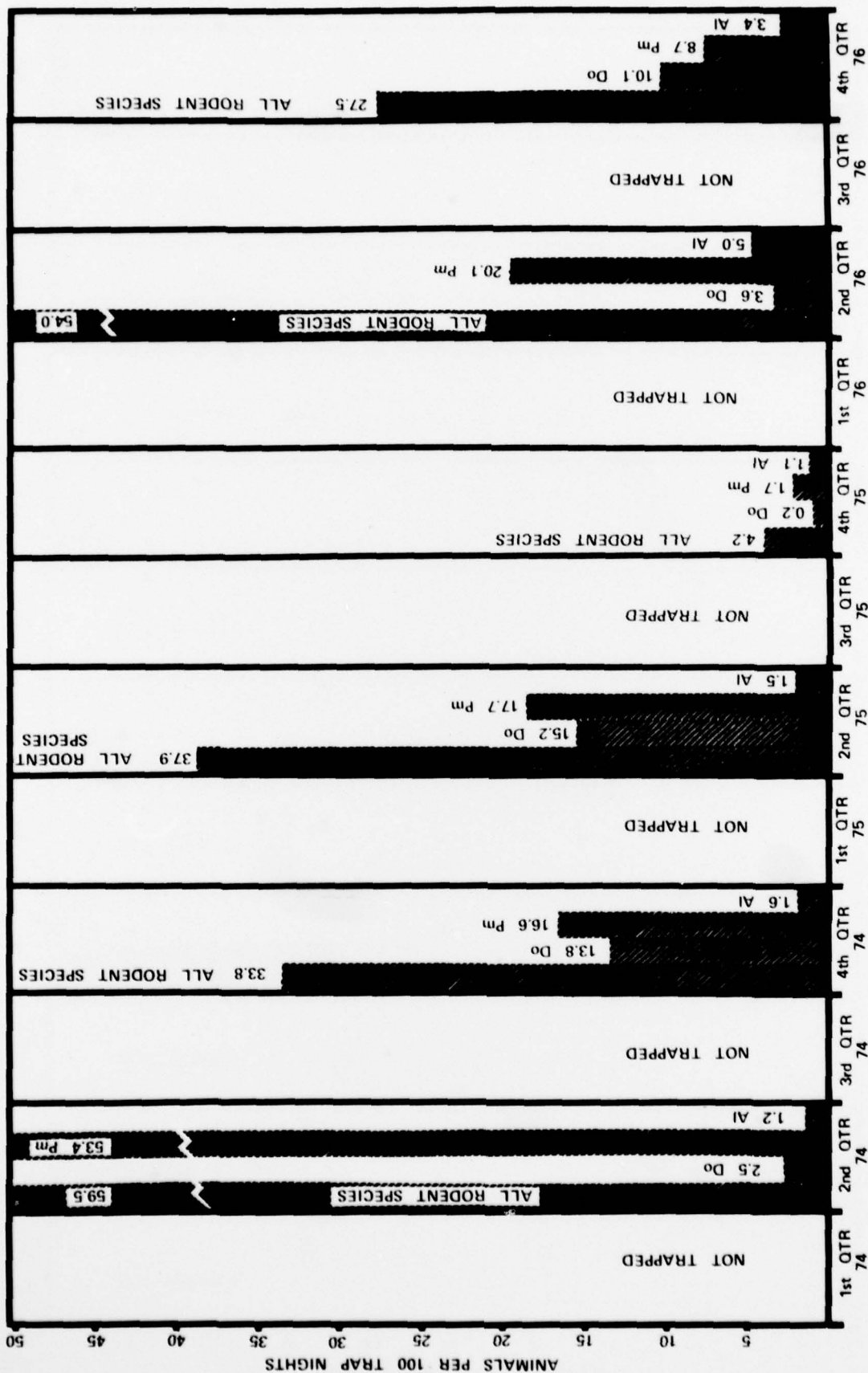


Figure B-3. Density distribution of rodent species collected in the Gold Hill area

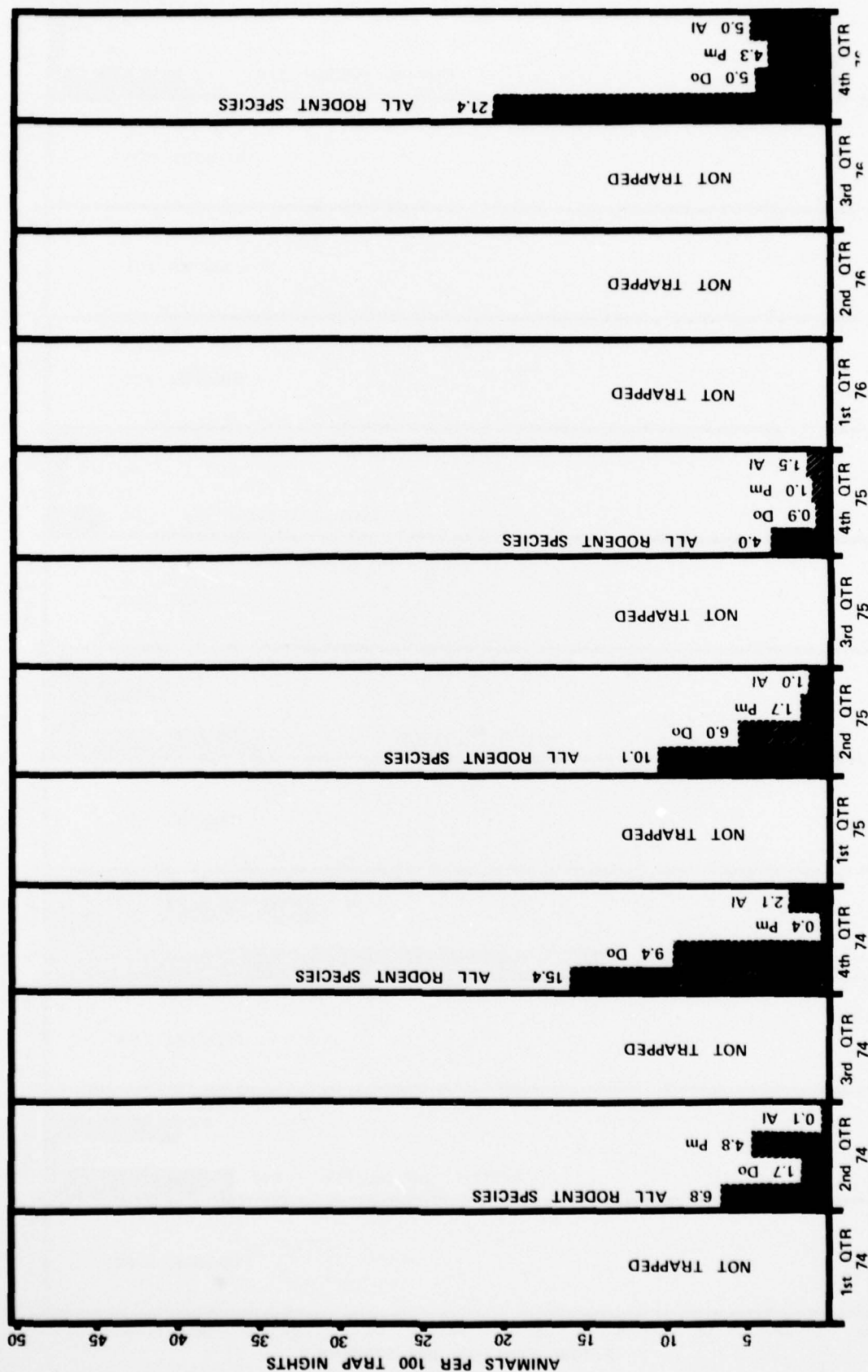


Figure B-4. Density distribution of rodent species collected in the Fish Springs area

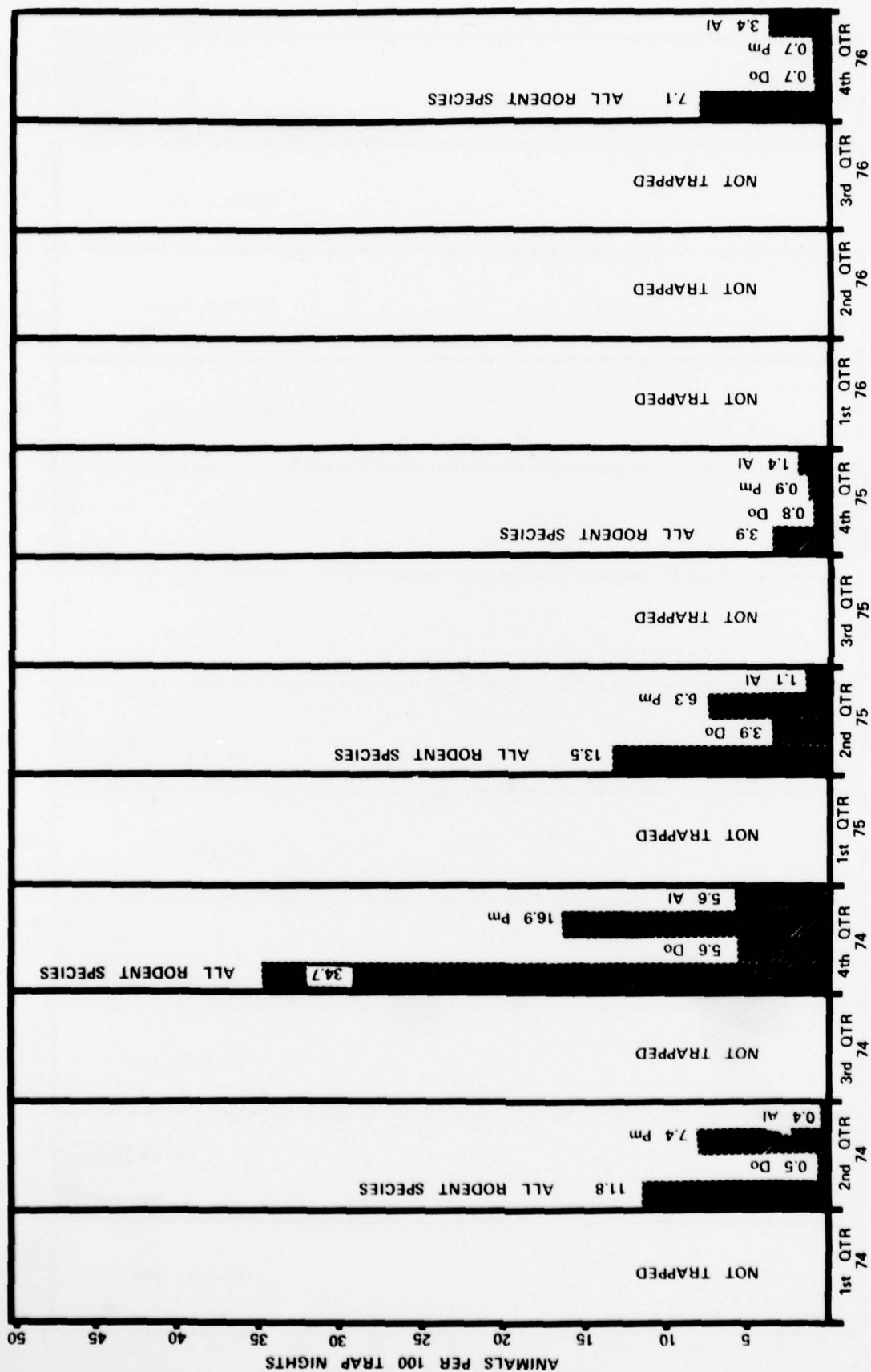


Figure B-5. Density distribution of rodent species collected in the Callao area

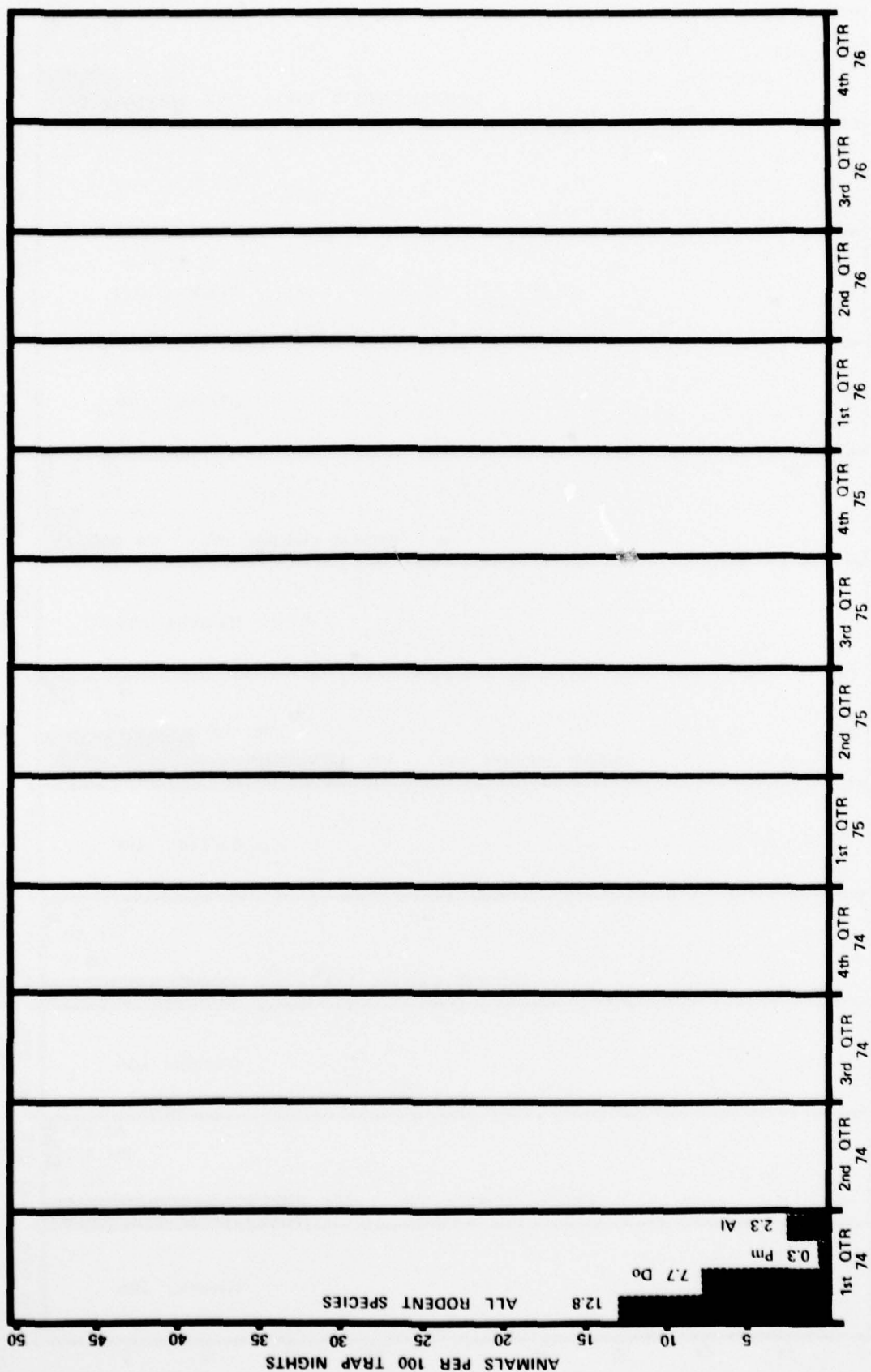


Figure B-6. Density distribution of rodent species collected in the Wild Cat Mountain area

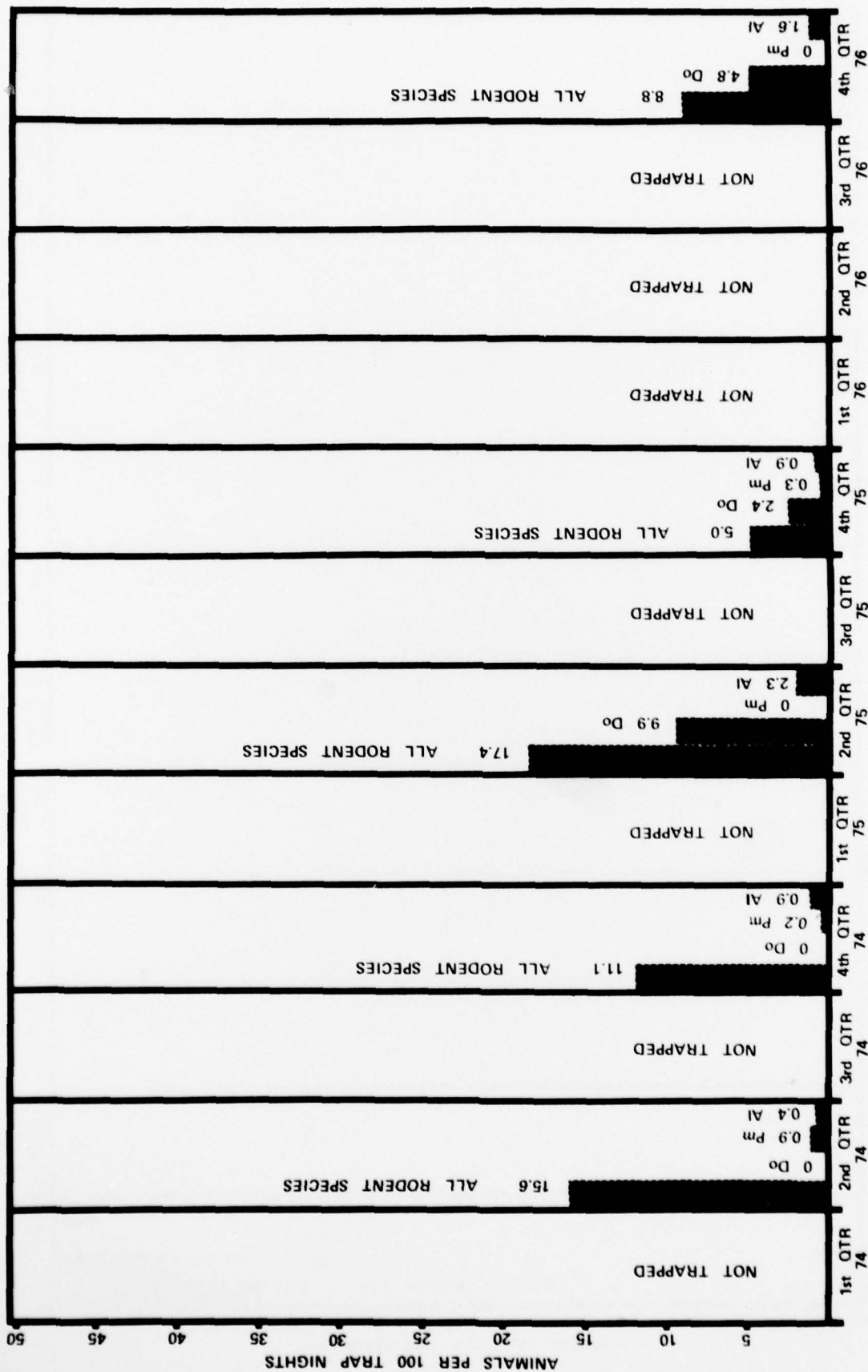


Figure B-7. Density distribution of rodent species collected in the Dugway Mountain area

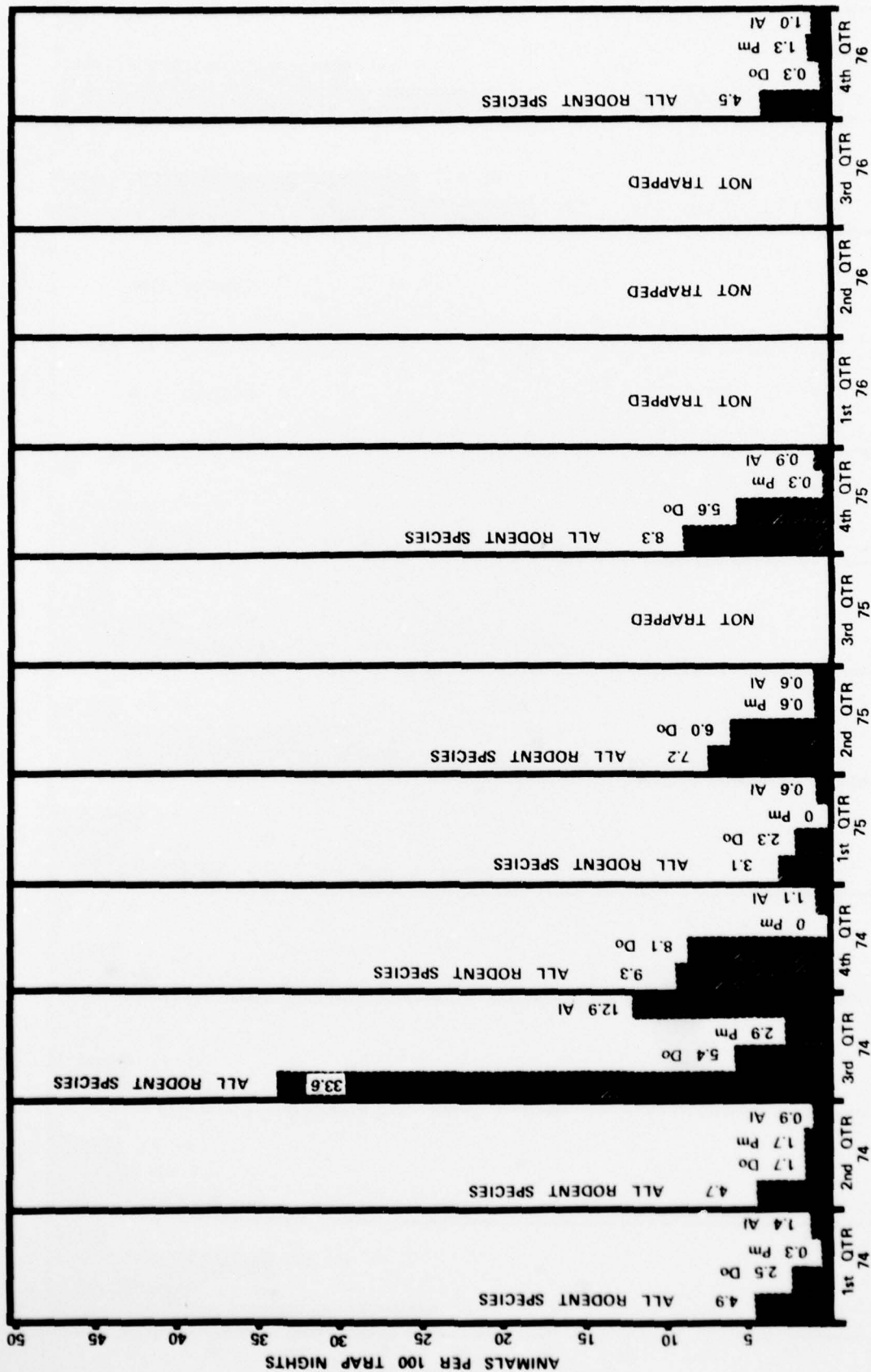


Figure B-8. Density distribution of rodent species collected in the Granite Mountain area

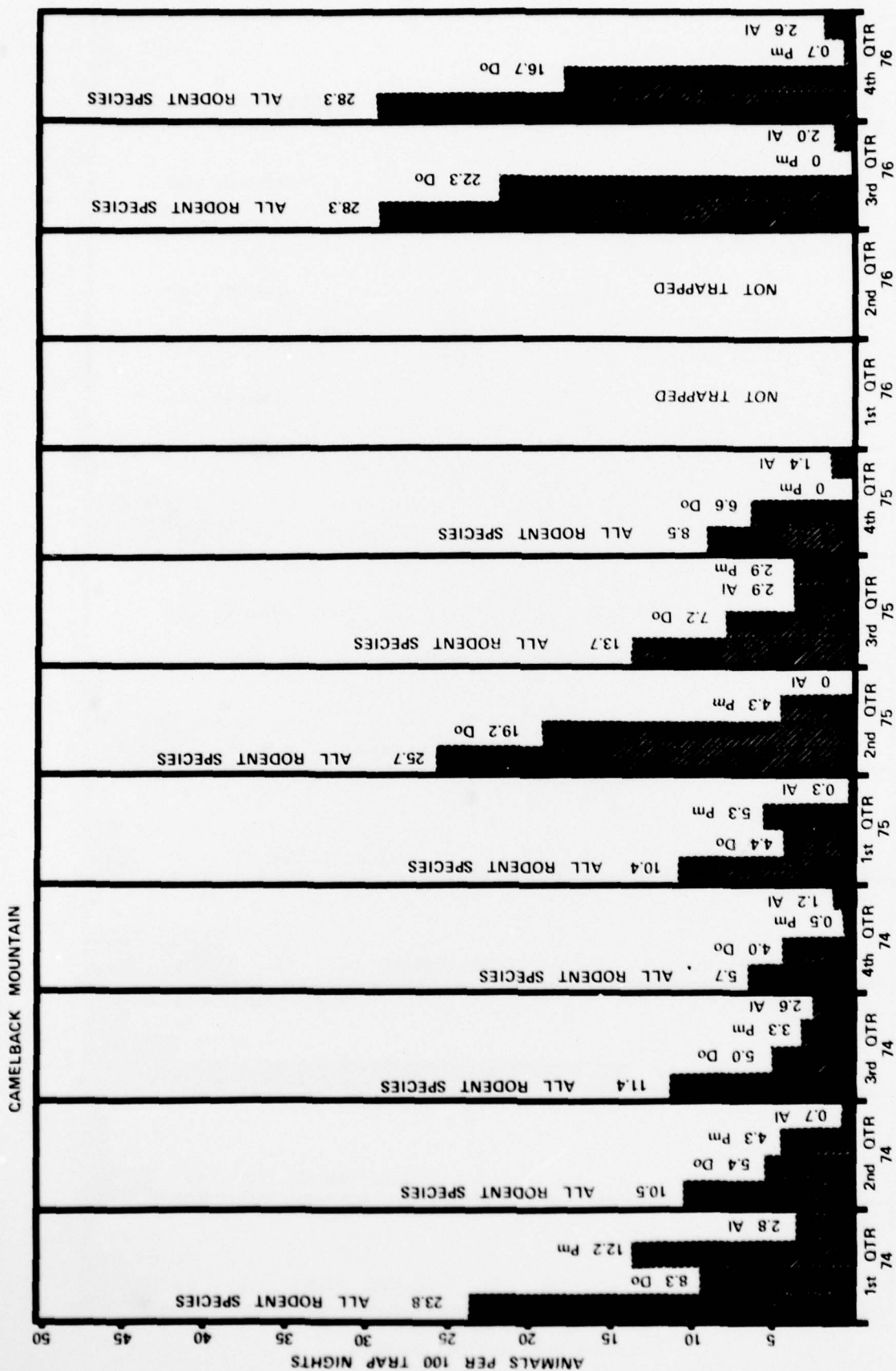


Figure B-9. Density distribution of rodent species collected in the Camelback Mountain area

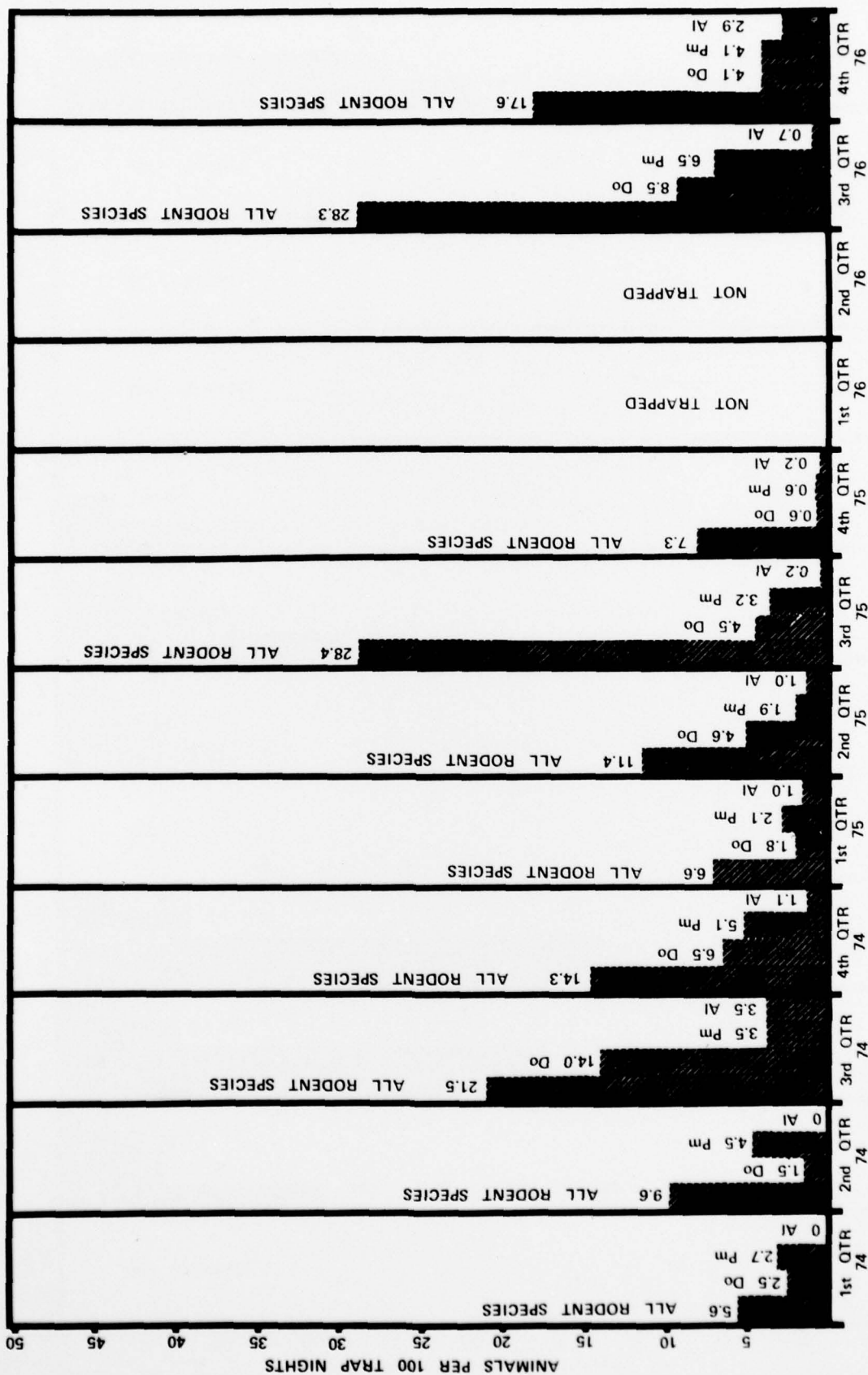


Figure B-10. Density distribution of rodent species collected in the Dugway Valley area

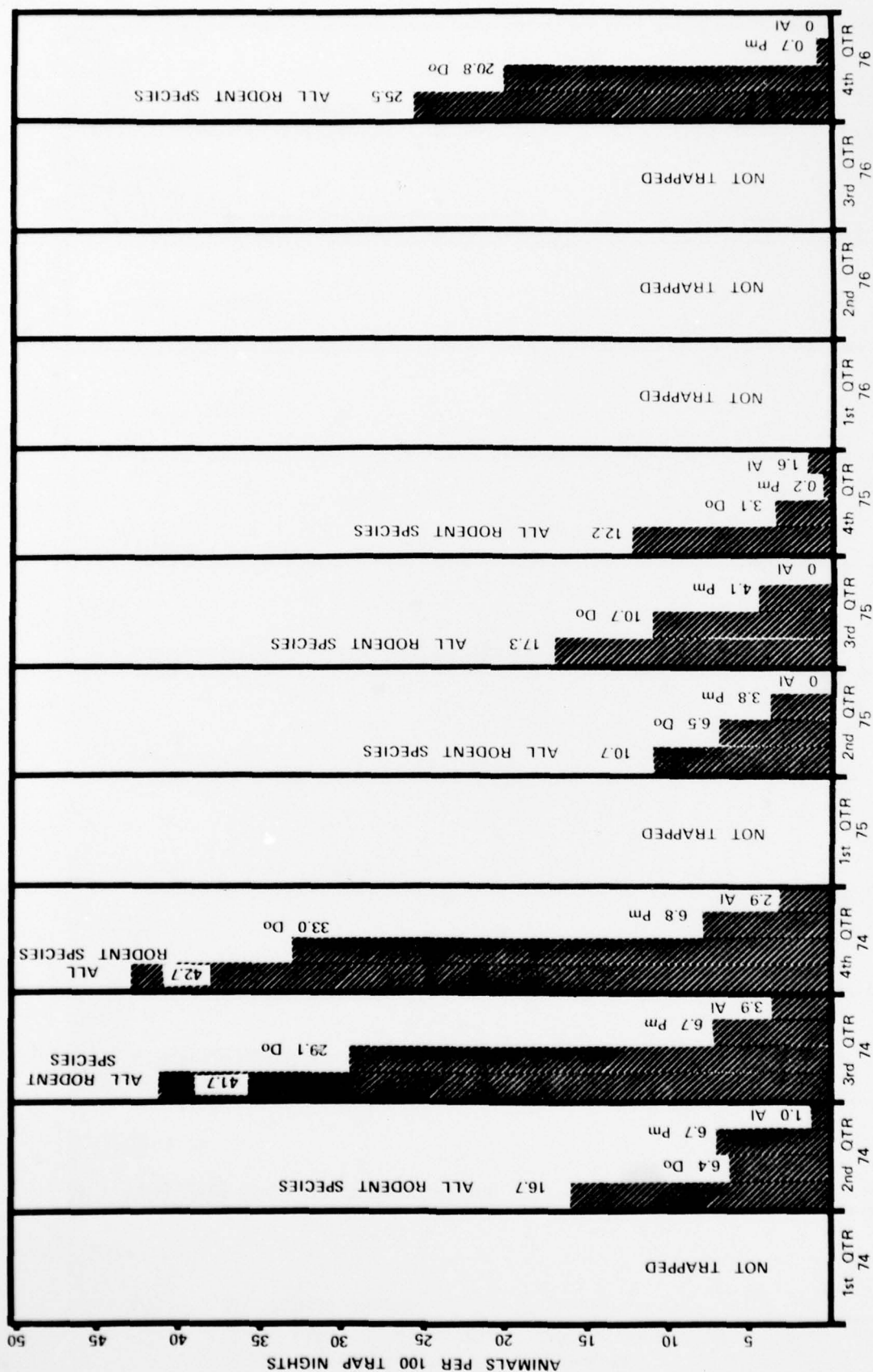


Figure B-11. Density distribution of rodent species collected in the Government Creek area

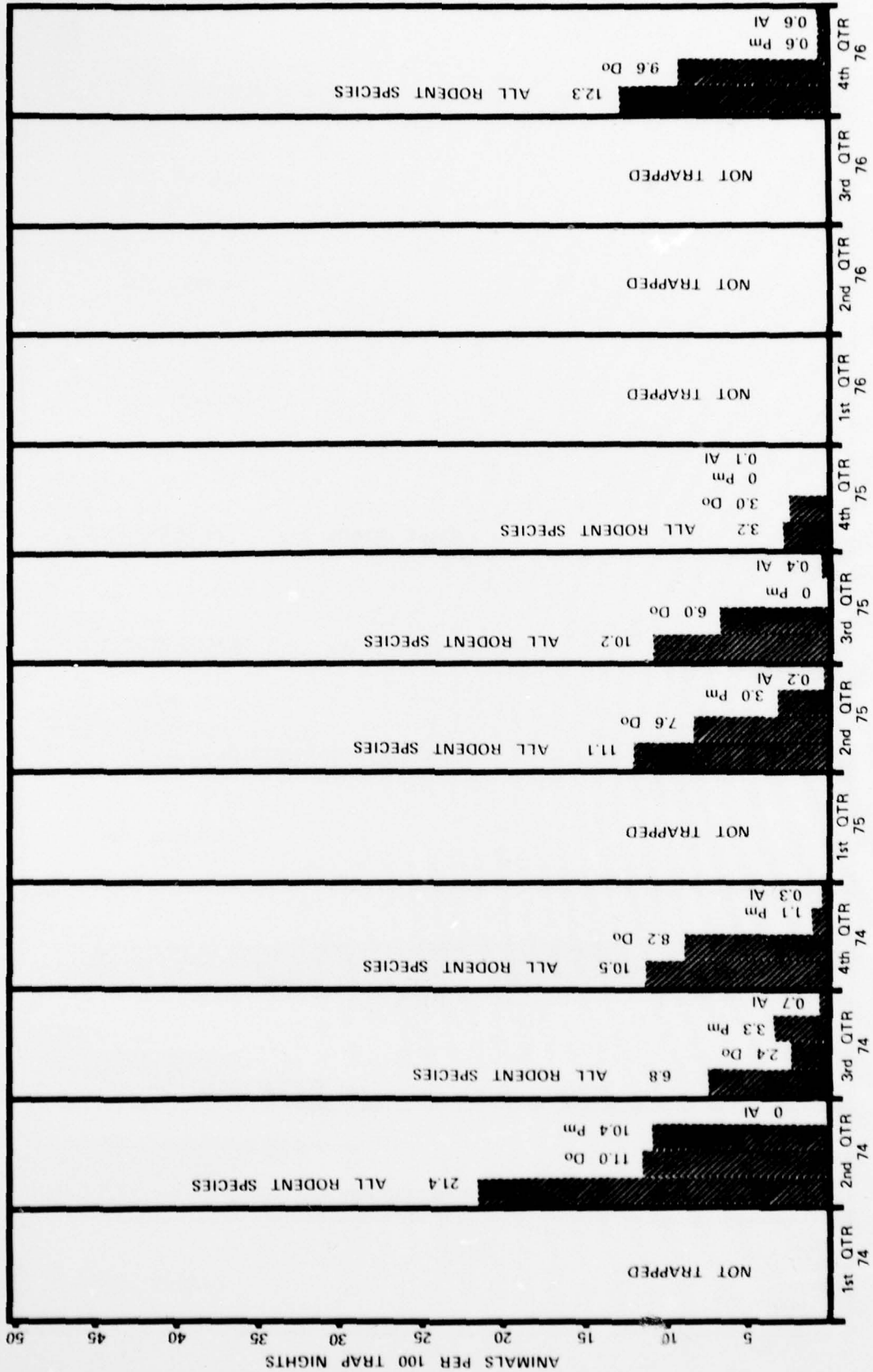


Figure B-12. Density distribution of rodent species collected in the West Cedar area

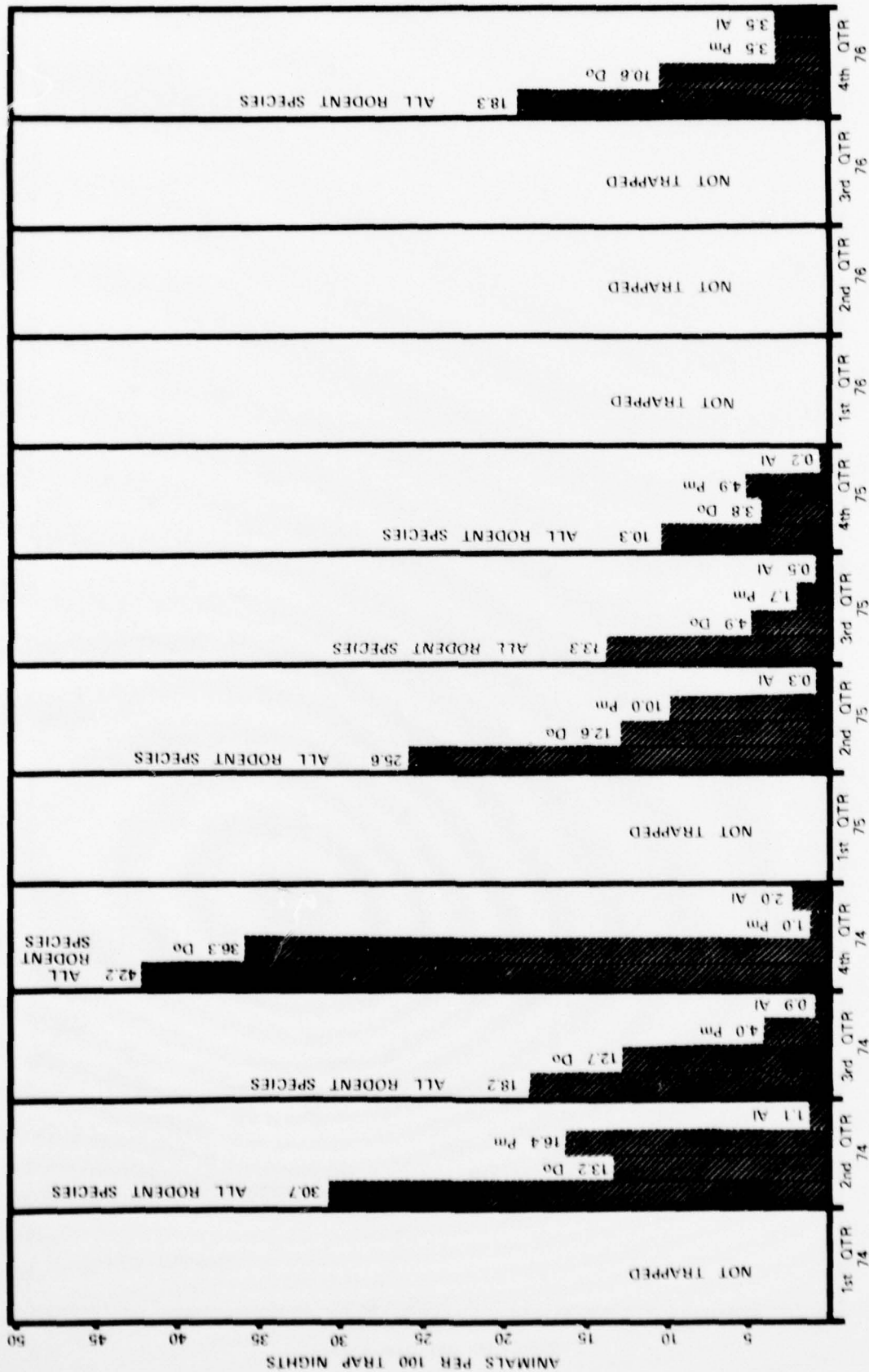


Figure B-13. Density distribution of rodent species collected in the South Cedar area

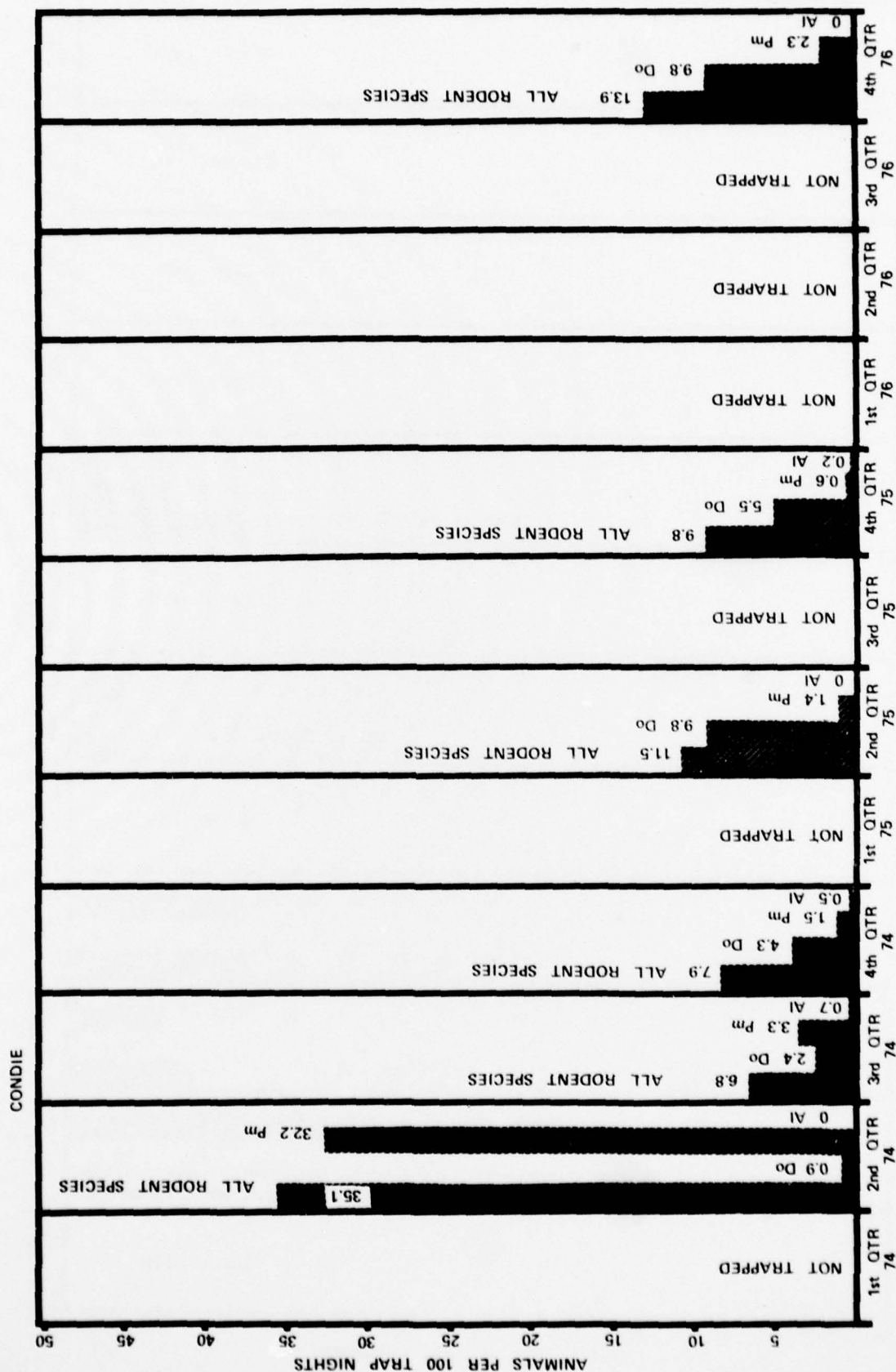


Figure B-14. Density distribution of rodent species collected in the Condie area

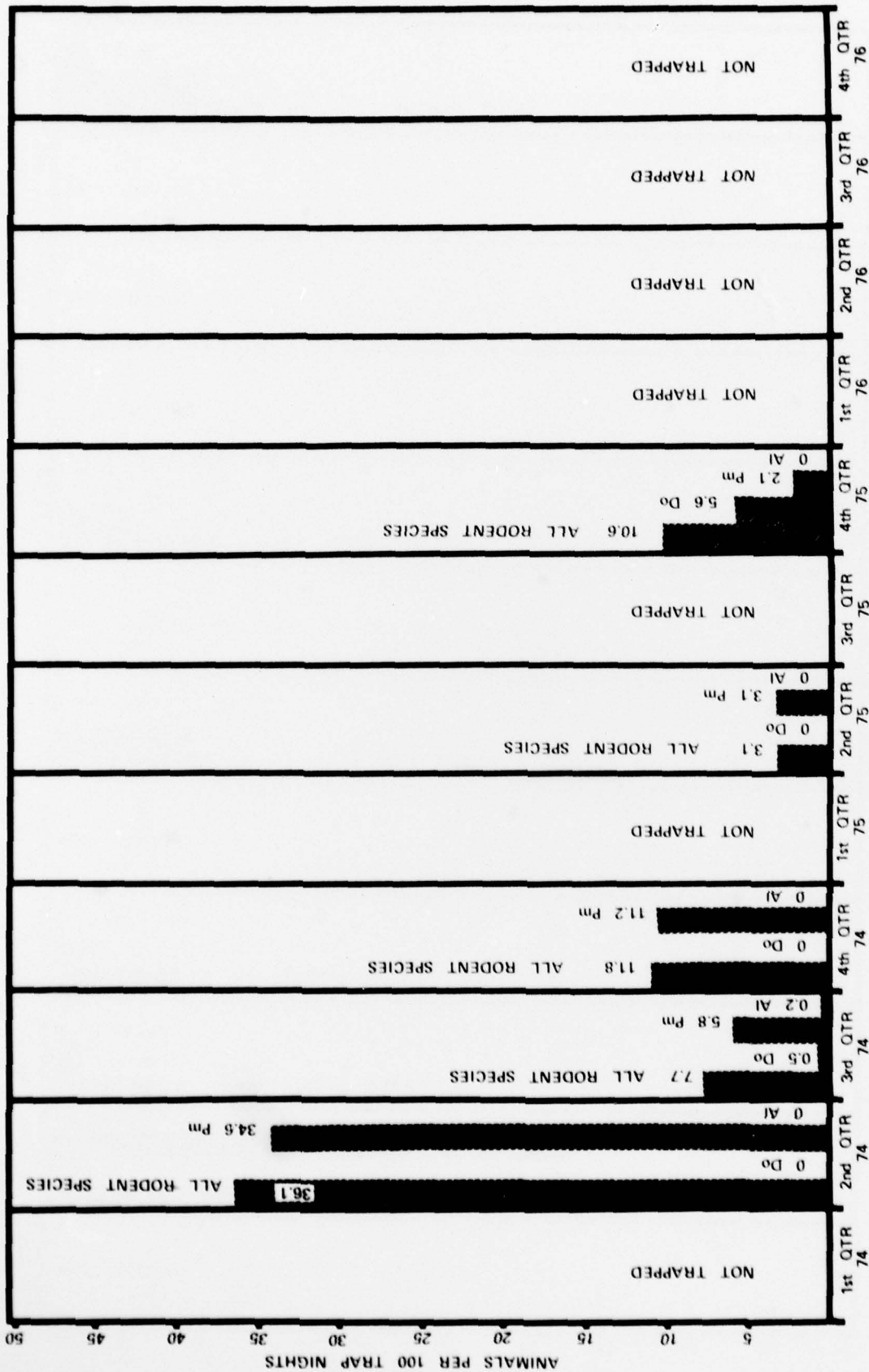


Figure B-15. Density distribution of rodent species collected in the Iosepa area